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HANDBOOK

FOR THE

8-INCH R.M.L. HOWITZER OF 70 CWT., MARKS I & II, ON SIEGE TRAVELLING CARRIAGE.

(LAND SERVICE.)

PERMANENT WORKS.

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1886.

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CONTENTS.

	PAGE
Howitzer and sights	3
Carriage	5
Pivots and Pivot Blocks	8
Apparatus, Anchoring	8
Platform, wood, double-decked	9
Guide wheel, platform	9
Plank, trail	10
Limber	10
List of stores that can be carried on carriage and platform	10
List of stores that can be carried in limber box	11
General instructions for care and preservation	11
Projectiles	12
Fuzes	13
Instructions for the preparation of shells and fuzes, and the examination of filled shells	13
Charges	15
Directions for making up cartridges	15
Range tables	16
Table of gradients	24
Drill	25
Instructions for the disablement or destruction of guns by gun-cotton	28
„ „ use of Watkin's Clinometer	30

PLATES.

Howitzer	Plate I
Sights	„ II
Carriage (central pivot)	„ III
„ (for anchorage or front pivot) and platform	„ IV, & V
Projectiles	„ VI, VII, & IX
Fuzes	„ VI, VIII, & IX

MEMO.

This handbook is correct up to 9th August, 1886.

8-inch R.M.L. Howitzer, 70 cwt. (Marks I & II.)

Howitzer and Sights.

Howitzer.

(*Plate I.*)

(List of Changes, §§ 4011, 4636.)

Material	exterior	Mark I,	Wrought iron.
		„ II,	Steel.
	tube		Tough steel.
Length	nominal		110·125 inches.
	total		113 inches.
Weight, nominal			70 cwt.
Bore	calibre		8 inches.
	length		96 inches.
	capacity, including chamber		4958 cubic inches.
Chamber	diameter		8 inches.
	length		8 inches.
	capacity		307 cubic inches.
Rifling	system		Polygroove, plain section.
	twist		Increasing from 1 turn in 90 cals. at breech to 1 turn in 35 cals. at muzzle.
	length		88 inches.
	grooves: number		24.
	grooves: depth		0·05 inch.
	grooves: width		0·7 „
Vent			Vertical, of hardened copper, 2 inches from end of bore.

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In order to ensure an exact cubical space in the bore being left for the charge, the grooves terminate abruptly at a distance of 8 inches from the end of the bore, so as to prevent the projectile being driven beyond this point. The grooves are slightly splayed at the muzzle to facilitate loading.

Planes for cross-levelling are cut upon the cascable button and the front portion of breech-coil (Mark I) or jacket (Mark II), and a plane for quadrant elevation on the top of the breech.

The elevating plate for the arc is attached to the right side of the breech, and is adapted to fit the piece for the 64-pr. travelling carriage.

Sights.

(*Plate II.*)

The piece is sighted on both sides, on the plan proposed by Major French R.A.

The tangent sights drop into sockets, and are set vertically. The bars of steel are graduated to 15°, adjustment being effected by removable clamps.

The sights have bronze heads with clamping screws, and a steel horizontal cross bar, which slides within the head to the extent of 1° to the right, and 3° to the left, to compensate for wind and deflection of projectile. The bar is provided with a sliding reversible leaf, having a notch for direct laying; this leaf is provided with a pointed sight for rough laying, and cross wires for fine laying when used reversed. The bar is graduated from 0° to 8° right for the right side, and 0° to 8° left for the left side. The bars are reversible, being graduated upon one edge for the right side, and on the opposite edge for the left side of the piece, and are stamped accordingly.

The fore sights consist of steel stems with horizontal cross bars forged solid, fitted into gun-metal sockets with bayonet joint. The bars are each fitted with a sliding reversible leaf, having a point for direct laying and an open notch and eye-hole for rough and fine sighting when used reversed. The cross bars are graduated from 0° to 8° to correspond with the tangent sight bars.

These sights can be used for either direct or reverse laying.

For direct laying, the notch of the tangent sight is used in conjunction with the point on the fore sight, and for fine laying, the sliding leaves are exchanged, and the eye-hole and cross wires used in conjunction. For direct laying, the method of proceeding is the same as when using service sights of the ordinary pattern: the only special feature being that both sliding leaves must be clamped at corresponding divisions of the respective cross bars, so as to obtain a line truly parallel to the axis of the gun; any deflection which may be required is given on the part of the bar specially graduated for the purpose.

For reverse laying, the notch of the fore sight is used in conjunction with the point on the tangent sight, or the eye-hole of the fore sight with the cross wires of the tangent sight.

The mode of proceeding is as follows:—

The line of fire is obtained by any of the recognized methods (*see* Manual of Siege Artillery), after which the howitzer is laid by clinometer or quadrant for the first round.

Before firing, an "aiming point" is selected to the rear of the platform, in prolongation of the line joining the sights, the leaves of which are for the purpose shifted on the cross bars, and clamped in any required position, without restriction as to keeping to corresponding divisions; the tangent scale being at the same time set to any convenient elevation (which need not necessarily be the elevation at which the piece is laid).

If near to the platform, the aiming point must be supplemented by a plumb line suspended at a fixed point between it and the howitzer to mark the line of fire; but if at a considerable distance in rear, the use of a plumb-line can be dispensed with, especially when battens on the platform, or other means are used to ensure the gun being in the same position after each round.

After the first round any necessary correction for elevation or deflection is made, and the aiming point, as above described, is used to lay on, the clinometer being no longer necessary.

Before firing, the sights are securely clamped. After each round any required alteration in the amount of elevation or deflection is given on the tangent sight, and the howitzer being run up, is laid on the aiming point without altering the position of the sights, except when the plumb line is used, in which case, to avoid cross-lifting, it may be found necessary to shift both sliding leaves an equal number of divisions to right or left on the cross bars.

For night firing, or when there is much fog, a luminous aiming point is required. This may conveniently be obtained by the use of a bull's-eye lantern, with wires crossed in front, fixed to a post; the light being softened by placing paper or other suitable material over the glass. In this case a plumb-line will usually be required, and the aiming point will be the point where the plumb-line covers the intersection of the wires on the lantern.

Battens or chalk-lines on the platform will generally be found useful.

The following sights and fittings (exclusive of spare) are issued with the piece :—

Clamps, tangent, sight "B," bronze	2
Plate, elevating, bronze, with pivot,* keep pin,† and 4 fixing screws	1
Screws, plate, elevating, preserving	4
Sights, R.M.L., cross bar { fore	2
Sights, R.M.L., cross bar { tangent	2

Carriage, Siege, R.M.L., 8-inch 70-cwt., Howitzer. Mark I.

(Iron, with hydraulic buffer, shifting roller, and two lashings, without limber.)

(*Plates III, IV, V.*)

(List of Changes, § 4531.)

The carriage used for this howitzer is that for the 64-pr., but strengthened and fitted with a hydraulic buffer. The carriage is formed of two bracket sides, of iron plate on the inner side of an angle iron frame, connected by transoms, bolts, and a trail piece with steeled eye. It is strengthened by a plate near the centre transom forged with a lip at each end, and secured to the top flanges of the angle frames of the brackets to restrain any outward tendency. It has an axletree bed with first-class axletree, and siege wheels 5-feet diameter 6-inch tire, with metal naves and phosphor-bronze pipes. It is fitted with elevating gear on the right side only, and also for a hydraulic buffer, and is provided with a brake as well as a scotch roller and two drag shoes with chains for travelling. There are firing and travelling trunnion holes, the former provided with capsquares.

The axletree bed is of wrought iron, constituting with the axletree a beam of box-girder section ; it is connected to the brackets by angle stays.

The elevating gear is of the worm wheel pattern, and consists of a worm shaft or endless screw with hand wheel, held in bearings on the outside of the carriage bracket, gearing into the teeth of a worm wheel (fitted with friction cone), which gives motion to a pinion on the inside of the bracket gearing with the arc attached to the gun. The arc is kept in gear with its pinion by a metal friction roller on the bracket. The worm wheel and endless screw are covered by a metal guard, made in two parts, and hinged together, so as to give ready access to the wheel, &c. The friction cone in the worm wheel should be adjusted by the nuts on the end of the spindle, to allow a slip of about 2° each time the gun is fired, to reduce the strain of the elevating gear.

A stool bed of wood, strengthened by angle iron along each side, large coin, and medium and small hand coins, are issued with each carriage, for use in laying the gun in case of any damage to the elevating gear. The stool bed also serves as the shifting plank for the gun roller No. 3 (also supplied), when required to shift the gun from, or to, the travelling trunnion holes. A pocket for priming irons is strapped on the rear transom.

The carriage is fitted to carry a hydraulic buffer suspended under it. The fittings for the buffer for anchorage or front pivot consist of :—Two vertical rods suspended from wrought-iron brackets under the axletree bed ; and two

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* Termed Pivots, elevating, "B," in 1886 edition of Vocabulary.

† Termed Pins, keep, pivot, plate, elevating, in 1886 edition of Vocabulary.

rods secured to wrought-iron brackets under the trail, and to the trunnions of the hydraulic buffer. The rods suspended under the axletree bed are each fitted at the lower end with a bearing with jointed capsquare and French key to support the buffer by its trunnions. For travelling, the capsquares are opened, the buffer trunnions released, and the buffer secured close under the axletree bed. When required for central pivot, the trail is fitted with additional brackets for the connecting rod of the buffer. Two of those brackets are fixed between the trail, and one to the rear transom; the piston and connecting rods are attached to the brackets by two steel bolts.

Hydraulic Buffer.

The buffer is of the special pattern for use with siege howitzer carriages. The front and rear caps are of wrought iron, and screwed on the cylinder; a ring with trunnions is secured near the centre of the cylinder and connected with the front cap by tie bars; the front cap is arranged with a leather packing ring, and also for cotton instead of the usual hemp packing. The piston rod is 2·75 inches diameter, and the front end is screwed to receive a link, by means of which it is shackled to the anchoring bar. The buffer being fixed to the carriage by its trunnions, and the piston rod shackled to the anchoring apparatus, when the carriage is run up, the piston rod is pushed into the cylinder, and the piston pushed by the rod to the rear of the cylinder, the oil passing to the front of the piston. As the carriage recoils, the piston and rod are drawn down the cylinder, the resistance offered by the oil to the passage of the former checking the recoil.

In the hydraulic buffer for siege carriages, the size and number of holes in the piston do not vary. There are four holes of 0·35 inch diameter.

Spare packings are supplied for the gland. A spanner for tightening the gland (spanner, hydraulic buffer, No. 1), as well as a spanner for the plug and cock (spanner, hydraulic buffer, No. 6) are also issued for use with the buffer.

The buffer is 5 feet 1½ inches long internally, the piston is 2 inches thick, thus the buffer allows of a possible recoil of 4 feet 11½ inches; practically, 4 feet 9 inches should never be exceeded.

Working contents of buffer .... 20½ quarts.

Before action, see that the cylinder contains the requisite quantity of oil, that there is no leakage at the gland, that the buffer is properly attached to the carriage with the tie bars secured by the split keys, and that the piston rod is properly shackled to the anchoring apparatus, or (if for central pivot) to the connecting rod attached to the trail.

To fill the cylinder with oil:—Run the carriage up, take out the screw plug from the filling hole, and by means of the gallon measure fill the cylinder. Oil is withdrawn through the front screw valve, air being let into the cylinder at the same time by the removal of the screw plug.

If leakage occurs at the gland, and tightening up the latter does not remedy it, the packing must be renewed.

To renew the packing:—Remove the shackle on the piston rod, unscrew the metal gland with the "Spanner hydraulic buffer No. 1," and with the tang of a file, extract the cotton packing, then by drawing out the piston rod the remaining portion of the packing, *i.e.*, the metal ring and leather collar, will come out with it.

Place the new leather on the rod, taking care not to damage its thin edge, follow it with the metal ring, and press them both home to the bottom of the stuffing box; then after inserting the cotton packing, tighten up the whole with the metal gland. The cotton rings, which should be ¼ inch less in length than the circumference of the piston rod, must have the ends bound with cotton yarn. When required for use, the rings must be well greased with tallow, and placed in the stuffing box so that the ends break joint.

If necessary to withdraw the piston and rod from the cylinder, the buffer must be removed from the carriage, and rigidly lashed to skidding to prevent it turning while removing the rear cap. After warming the cap with a piece

of hot iron (which by softening the red lead and expanding the iron facilitates removal), unscrew it by tapping the spanner with a hammer; the shackle should be detached, and the gland slackened before removing the piston rod. During the above operations, great care must be taken to prevent damage to the component parts.

To replace the piston and rod:—Slide the latter up the cylinder to the front cap, then with the tang of a half-round file inserted through the stuffing box, prize it into its bearing while it is being forced forward from the rear. Before replacing the cap coat its thread, and that of the cylinder with red lead.

To connect the buffer to the carriage:—Lay the buffer with the filling hole uppermost, beneath the carriage in a line with the axis of the gun, lift the tie bars, and attach them by the connecting bolt to the brackets on the trail, then raise the buffer with a handspike and secure its trunnions in the bearings by the capsquares and keys provided for the purpose.

For travelling, the piston and rod are pushed home in the cylinder and secured by a strap, the thick end of the shackle pin being uppermost; the buffer is then lifted by handspikes, and secured by the chains on the carriage. The vertical rods are folded backwards, and rest on the top of the cylinder.

The Brake.

The brake consists of a bar of trough iron resting in staples under the brackets, having a strong steel spring secured at each end, to which are attached wrought-iron shoes carrying wood blocks. The brake is put on by means of a steel lever handle, working in a rack plate on the outside of the *right* bracket. This lever fits on the end of a cross shaft, passing through the brackets at the front. On each end of this shaft is a crank, which is connected by a tension bar, with adjusting screws to the trough carrying the springs. When the lever handle is pulled down to the travelling rear of the carriage, the wood blocks are pressed against the wheels.

The blocks can be replaced when worn out by spare ones.

The Roller, scotch,

Is a small roller hooped at each end, and with four horizontal plates between the hoops, having a spindle passing through with a loop at each end, to which is welded a chain with hook. When the roller is required for use, that is, when ascending a hill, one chain is hooked to an eye on the axletree bed, and the other to the loop washer on the end of the arm.

NOTE.—The brake gear, scotch roller, and drag chains, should be removed when in "action." To remove the brake:—Take off the collars on the cross shaft to disconnect the tension bars, and unbolt the staples supporting the trough iron bar.

							ft.	in.
Height to centre of gun						....	4	5
Length of	carriage	with wheels				....	11	10½
		without wheels				....	10	11½
	axletree					....	6	3
Angle of trail						19°		
Elevation, maximum						35°		
Depression						5°		
Wheels	track					....	5	2
	diameter					....	5	0
							cwt.	qrs. lb.
Weight	carriage, with wheels, brake, hydraulic buffer, drag shoes, and arc, elevating					....	45	0 0
	wheels (two)					....	10	2 0
	hydraulic buffer, empty					....	4	0 23

Central Pivot.

(*Plate III.*)

When the carriage is employed with a central pivot, the buffer is reversed, and attached by special fittings to the carriage and pivot.

A guide in the form of a wheel which revolves around the top of the pivot block, is used to ensure the carriage being "run up" with its centre over the axis of the buffer, and thus prevent strain on the piston rod.

The pivot consists of a cast-iron pivot block, and a steel pivot plug. The latter is forged with a crutch head which has suitable bearings for the buffer trunnions. The guide is a wheel with wood spokes and felloes, bound with a 3-inch ring tire, and fitted with a special cast-iron nave bored to a suitable size for the top of the pivot block.

When in position, the buffer trunnions are secured to the pivot plug by caps, and the piston rod is attached by a connecting rod to the trail. The connecting rod is steadied and held in line by two steel bolts passing through iron brackets fitted on the carriage.

NOTE.—These brackets and bolts are additional to those used when the carriage is attached to the anchoring apparatus.

Front Pivot.

(*Plate V.*)

The same fittings are used on the carriage for this pivot, as for a front anchorage. A ground traversing platform is used with this pivot, having two sides of teak with transverse pieces and a trail plank also of wood.

At the front of the platform on either side, is a metal roller on an eccentric axle with a socket for an iron pointed lever, to facilitate traversing. Handspikes are used under the trail plank.

Pivot Blocks.

The same pattern pivot block is suitable for both pivots.

For the central pivot the upper surface of the block should be 4 inches above the ground line; for the front pivot 13 inches.

Apparatus, Anchoring, Carriages, Siege, with Buffers, Mark I.

(List of Changes, § 4430.)

It consists of an iron tie rod 1½ inches diameter and 12 feet 5¼ inches long, having at one end a shackle and bolt to connect it with the eye of the piston rod of the buffer, and at the other end a "plus thread" screw fitted with a nut and iron plate 1 inch by 9 inches square to secure it to the beam. This iron plate has a circular hole 1¾ inch diameter in centre, through which the tie rod passes. Two iron links are attached to the tie rod to allow, if necessary, of greater lateral training.

There is a beam of oak 9 inches by 9 inches by 10 feet long, with a circular hole 1¾ inch diameter in the centre, another also of oak 4 inches by 9 inches by 3 feet long without any hole; this latter beam is to prevent the tie rod being forced through the large beam when running up the howitzer.

In laying the anchorage, which would necessarily have to be done in constructing the battery, the 10 foot oak beam should be laid at such a depth that the tie rod, when shackled up, will be parallel to the upper surface of the platform (generally laid at a slope of 1 in 24) and at such distance from the interior slope of the parapet, that the eye of the tie rod will just be clear inside the revetment, and so be in a convenient position for shackling up.

It is essential that the position of the shackle should be such that its bolt will be vertical, so as to admit of lateral play when traversing in the process of laying the howitzer. The height of the shackle from the level of the platform, will depend upon the height of the axis of the buffer. It should be 1 inch less than the height of this axis.

Weight, 3 cwt. 1 qr. 21 lbs.

Platform, Siege, Double Decked (Wood).

(List of Changes, § 4224.)

The platform consists of two layers of 3 inch fir planks, those of the bottom layer parallel to the line of fire, those of the upper layer at right angles to it; under the bottom layer are placed four transverse planks, similarly to those in the top of layer, one at the front, another at the rear of the platform, the other two dividing the distance between them. The layers are connected by 5-inch coach screws through both ends of all the transverse planks. Two short hurters, each 3 feet by 6 inches by 6 inches, are also provided to prevent the carriage running up too far. These hurters, which are each secured by four 9-inch coach screws, are laid down with an interval of about two feet in the clear between them, so that the buffer with which the carriage is anchored may not foul them. They should not be secured until the gun is placed in the firing position with the piston rod home in the buffer; they should then be screwed down in contact with the front of the wheels.

One platform consists of :—

Bottom layer, 16 planks	18	feet	by 9	inches	by 3 inches.
Top layer, 24 planks .... }	12	„	9	„	3 „
Transverse planks, 4 .... }					

48 5-inch coach screws, $\frac{5}{8}$ inch diameter.
8 9-inch „ $\frac{5}{8}$ „ „
2 hurters 3 feet by 6 inches by 6 inches.

Almost any scantling may be used for hurters.

These platforms should be laid at a slope of 1 in 24 (2° 23′) to the front, with a clear space of 1 foot between the front of the platform and the foot of the interior slope.

The object of this arrangement is :—

1. To leave a sufficient gangway between the front of the wheels and the interior slope, so as to enable the officer or No. 1 who lays the gun, to pass round to the front of the trunnions when the gun is in the firing position to lay "reverse."

2. For convenience of drainage.

3. To prevent the earth and stones shaken down by the shock of firing falling on the platform. The average weight of double decked platforms is about 35 cwt.

These platforms will be carried and laid by the Royal Engineers.

Guides, Wheel, Platform, Siege, Mark I.

(List of Changes, § 4435.)

These guides are of elm, plated with iron on the curved edge. Two such guides are issued with each platform. They should be screwed down on the platform after the carriage has been run up to the firing position, and the buffer shackled to the anchoring apparatus; care being taken that the piston rod is in exact prolongation with the tie rod.

The object of the guides is to ensure the carriage each time it is run up being in a correct position with regard to the anchorage, and to simplify the process of laying "reverse."

Weight of each guide, 1 qr. 15 lbs.

Plate, Wheel Platform, Siege, Mark I. (Steel).

(List of Changes, § 4435.)

The wheel plates are of steel ½ inch by 18 inches by 6 feet. One of these plates is to be placed under each wheel of the carriage to protect the upper layer of the platform.

Weight of each plate, 1 cwt. 2 qrs. 10 lbs.

Plank, Trail Siege, Mark II.*

(List of Changes, § 4435.)

The trail plank is of oak 12 inches by 3 inches by 6 feet, shod on both sides for the whole of its length with channel steel, and fitted with four rope handles. It is to be placed under the trail of the carriage to preserve the ground platform from injury.

Weight, 2 cwt. 1 qr. 7 lb.

Limber, Siege, R.M.L. Howitzer.

The limber is the service wrought-iron siege limber, the futchels and splinter bar are of wrought iron; the axletree bed is also of wrought iron, and with the axletree constitutes a beam of box-girder section.

The wheels are 2nd class, B. No. 25, Mark III. "The washer is a 'loop washer,' having a shorter loop than the usual drag washer."

The limber is fitted with a limber hook, steeled with a piece of steel welded in to prevent wear, and fitted with a steel key, 1¼-inch diameter

The shafts are, one pair "near" and "off," the former being of the field pattern, and the latter similar to the field pattern, but having a loop on the iron for the stay of the outrigger; also another pair "framed" and attached to the splinter bar. There are outriggers for four-horse draught.

The limber is arranged with one box to contain the sights, small stores, and elevating arc. This box is common to the R.M.L. 8-inch, 70 cwt., 6·6-inch, and 6·3-inch Howitzers when used in the siege train.

		cwt.	qrs.	lb.
Weight	limber and shafts	6	3	22
	wheels	4	2	4
	store box, empty	1	0	12

List of Stores that can be carried on the Carriage.

	No.		No.
Arc, elevating	1	Roller, shifting	1
Brush, water	1	„ Scotch	1
Coins, wood, hand	3	Spanner, McMahon's	1
Hammer	1	Socket, priming irons	1
Handspikes	5	Stool bed	1
Pincers (pairs)	1		

List of Stores that can be carried on Limber.

	No.		No.
Axe, felling	1	Ropes, drag (pair)	1
Box, tin, grease, 3-lbs.	1	Swingletrees	3
Buckets, cavalry	2	Shovel	1
Hook, bill	1	Spade	1
Jack, lifting, Clerk's	1	Spanner, hydraulic buffer, No. 1	1
Maul	1	Washers, drag, 1st class	1
Pickaxe	1	„ „ 2nd class	1

* In the drawing (Plate III.) a trail plate of iron is shown, this being a special one issued for Hongkong.

List of Stores for the R.M.L. 8-inch 70-cwt. Howitzer, that can be carried in the Siege Train Limber Box.

		Nr.
Bit, vent, 17-inch	....	1
Can, oil, lubricating	....	1
„ „ feeding, 1 pint	....	1
Chalk, white	ozs.	4
Cock, metal, draw-off	....	1
Cloths, sponge	....	6
Couples, trace	....	2
Clinometer (in case)	....	1
Cylinder, with 6 bits	....	1
Driver, screw, shrapnel	....	1
„ „ steel, 6″	....	1
Drift, wood	....	1
Extractor, fuze	....	1
File, half round, handled	....	1
Hemp, undressed	lbs.	2
Hook, borer	....	1
Key, for metal lined cases	....	1
„ iron, fuze and plug	....	1
Knife, clasp	....	1
Leathers, gland	....	1
Line, hambro	....	1
Lanyards, friction tube	....	3
Line, chalk	....	1
Marline	lbs.	3
Match, slow	lb.	1
Measure, filling buffer	....	1

		No.
Portfires, common	...	2
Pocket, tube	....	1
„ fuze	....	1
Pir, linch, 1st class	....	1
„ „ 2nd class	....	1
Plummet, lead	....	1
Plug, screw, filling	....	1
Pricker, 12-inch	....	1
Reel, wood	....	1
Rope, cotton, white	lbs.	4
Stick, portfire	....	1
Sights, tangent, with cross bar	..	2
„ fore „ „	....	2
Spike, spring	....	1
Spikes, common	....	2
Scissors, laboratory	....	1
Spanner, hydraulic buffer, No. 1		1
„ „ „ No. 6		1
Tape, measuring	....	1
Tubes, friction	....	25
Twine, whipping	lb.	1
Vent servers, with lanyard	....	2
Wax, bees	ozs.	4
Washer, drag, 1st class	....	1
„ loop, siege limber	....	1

The box is also fitted to carry an elevating arc and a 2 gallon oil can if required.

NOTE.—There is also a smaller store box with slanting top, which may be issued with this limber, when the Howitzer is used otherwise than with the siege train, § 4629.

General Instructions for Care and Preservation.

Care should be taken that all nuts and screws are properly tightened up; if removed they should be slightly oiled before being replaced, and to prevent damage by the threads crossing a few turns should be given by hand before using the spanner.

On no account should a hammer be used in removing the nuts or screws.

All bright parts should be kept clean, and when not in use, slightly greased; all working parts must be kept free from clotted oil and dirt, and properly lubricated.

The axletrees and grease chambers of the wheels should be frequently cleared from clotted grease, and all dirt and grit removed before lubricating. To ensure thorough lubrication, the chambers must be kept filled with grease.

Store boxes should be removed occasionally and examined underneath.

Care must be taken to prevent the lodgment of water on any part of the mountings.

The points of the shafts should be kept off the ground when parked.

Defects or damage should be made good without delay; if the paint becomes rubbed off at any part, it should be patched over as soon as possible.

PROJECTILES.

(*Plates VI, VII, and IX.*)

(*See* Changes in War Stores, § 2188, 4031, 4199, 4337.)

			Weight. lb.	oz.	
Shell	Common	Empty	160	5	
		Gas-check	6	4	
		Bursting charge { P. 16 lb. 6 oz. / F.G. 3 lb. 12 oz. }	20	2	
		Total weight filled	186	11	± ·15 p.c.
	*Shrapnel	Empty	171	12	
		Gas-check	6	4	
		Bursting charge, F.G.	2	0	
		Total weight filled	180	0	
	Star, spherical, containing—				
			diam.	length.	
	12 stars		1·27″	3·35″	
	5 ,, ...		1·6	3·35	
	4 ,, ...		1·6	2·65	
	Total weight filled		22	0	± 0·15 p.c.
Shot, case, filled with 75–8 ozs. sand shot			74	0	
Gas-check, copper automatic, with projections			6	4	

Common Shells.

These shells are without studs, the bodies are unturned, being cast to the figured dimensions, leaving 0·15-inch windage, and bands are left at the base and head turned down to 0·05-inch windage.

Gas Checks.

The rotation is effected by means of the gas-checks, the curved portion of the base of the shell being cast with radial grooves, into which the inner surface of the gas check is compressed by the pressure on firing; the gas-check is also at the same time firmly attached to the base of the shell by being compressed into the groove or neck round the projecting part at the rear end of the shell. The gas-check is made with projections round the circumference corresponding to the rifling grooves of the Howitzer.

Incendiary Shells.

Incendiary stars are intended for filling common shells which are to be used for incendiary purposes. Each star consists of a hollow paper cylinder about 2 inches in length, 0·7 inch in external diameter, and 0·5 inch in internal diameter, soaked in paraffin wax, and filled with the following composition, viz.:—

India-rubber solution	2 oz.	Paraffin wax	0¼ oz.
Powder, mealed	5 ,,	Naphthaline	0¼ ,,
Saltpetre, ground	1 ,,	Coal tar	1 ,,

with half the weight of the mass of mealed L.G. powder added.

Each end of the star is primed with quickmatch.

The shell will hold about 255 stars, with (about) 5 lb. 6 oz. loose L.G. powder.

The stars are packed in tin-lined deal boxes, holding 200 stars; they are not wrapped in bundles, but over the stars a sheet of brown paper and paper shavings are placed before the closing plate is soldered down.

FIXING GAS-CHECKS.

The gas-checks can, if necessary, be attached by placing them on the base, painted side to the rear, and making four nicks with a spike-nail and hammer into the groove at the side of projection on base. It has been decided, however, that they should be loaded separately, and such is the drill.

* Not yet introduced.

FUZES.

(Plates VI, VIII, and IX.)

Percussion—Direct-Action.
Time—15 seconds with detonator 0·012 wire.*
15 seconds with special priming.

INSTRUCTIONS FOR THE PREPARATION OF SHELLS AND THE EXAMINATION OF FILLED SHELLS.

(See Army Circulars, 1st September, 1884.)

FILLING AND SECURING SHELLS.†

Common Shells.

Weigh out the charge in quantities in the proportion of P. 4 lb. and F.G. 1 oz., and drop one quantity of P. pebble by pebble into the shell. Then insert the funnel, and pour in one of F.G., tapping the shell with a wooden mallet to assist the latter in filling up the interstices between the pebbles. Repeat this operation till the shell is full, when the G.S. wad is to be inserted shalloon side downward, and the fuze-hole plug screwed in.

Shells, Star.

These shells do not require to be filled; they are ready for the insertion of the fuze when the plug is removed.

Common Shells for Incendiary Purposes.

The empty shell should be tilted to one side, and the stars put in gradually and occasionally "set" or shaken down, so as to bed themselves evenly together. (A small wooden stick will be found of assistance in getting the stars well in.) When no more stars can be inserted L.G. powder is introduced, the shell being tapped with a mallet or piece of wood, in order to have the shell completely filled. The fuze or plug will be then inserted, as may be required.

Before using a shell, it should be ascertained that there is powder close to the fuze-hole. These shells are fuzed with percussion fuzes.

FIXING PLUGS.

When plugs or metal fuzes are screwed into shells, they will be lubricated with Field's grease, No. 3, if for use at home stations or in British North America. Price's composite grease is to be employed at all other stations.

Instances have occurred in which fuze-hole plugs of common shells have been so jammed in as to be immoveable, in consequence of using the "Wrench, removing base-plugs of Palliser shells." The "Key, iron, fuze and plug, G.S.," and the "Key, iron, plug, G.S.," are the only implements which should be used for screwing in the G.S. plug.

DISTINGUISHING MARKS.

All filled shells must be marked with the word "Filled" and date, and the letter "P." to denote the bursting charge. The colour of the paint will be red on a black ground, or black on a red ground. At stations where means are available the monogram is to be painted.

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* This fuze will probably be shortly superseded by the 15-seconds sensitive fuze.
† Shells for siege purposes are issued filled.

Preparing Fuzes.

Fuzes, Percussion, Direct-Action.

These fuzes require no preparation except the removal of the metal cap; they are screwed firmly into the fuze-hole by means of the "Key, iron, plug, G.S," which fits into the square hole in the cap. This cap is fastened on to the head of the fuze by two double bayonet joints, which enable the cap to be used either in fixing or unfixing the fuze. The cap can be removed by bringing the centre of the bayonet joints in line with the studs on the side of the head of the fuze.

The cap will not be removed until after entering the shell into the muzzle.

Time, Wood, 15 secs., with Detonator.

These fuzes are prepared for any desired time of flight by boring through the side hole corresponding to the required time, into the composition.

When using the hook-borer place the fuze in the hook of the hook-borer in the proper position for boring the required hole; enter the bit into the side hole, screwing up until the bit has entered as far as the borer will allow, taking care to press the fuze with the fingers so as to ensure its bedding fairly in the hook.

Unscrew, and, when the bit is quite clear, remove the fuze from the hook. The length of the bit is so regulated that, when placed in the handle, it will enter sufficiently far into the composition when screwed down to the shoulder. If the bit should become unserviceable, the handle must be detached from the shank and the tightening-screw unscrewed, the square hole in the hook being made for that purpose. Care must be taken when substituting another bit that it is properly placed in the handle, and that the tightening-screw firmly presses upon it, for if any space be left between the handle and the head of the bit, the end will not enter a sufficient depth into the composition. The borer should be occasionally examined and cleaned. The operation of preparing the fuze and fixing it in the shell takes, on an average, about 15 seconds; with a little practice these operations may be performed in a shorter time.

Time, Wood, 15 secs., with Special Priming.

This fuze is for use with star shell only, and is distinguished by the head being painted red.

It is the ordinary 15-secs. M.L. time fuze with an extra priming of gun-cotton yarn, protected by a waterproof paper cap, which is held in its place by a tape and copper band.

It is prepared for any desired time of flight by boring through the corresponding side-hole into the composition. To do this the fuze is placed in the hook-borer in the proper position, the bit entered into the side-hole and screwed up as far as the borer will allow, care being taken to press the fuze with the fingers, so as to ensure its bedding fairly in the hook.

The bit is then unscrewed, and when quite clear the fuze is removed and inserted in the shell. When the latter is placed in the muzzle of the gun, the fuze is uncapped by giving a smart pull to the exposed end of the tape band.

Fixing Fuzes.

Fuzes, Time, Wood, with Detonator, and with Special Priming.

These fuzes should be screwed into the fuze-hole by hand; when they cannot be screwed any further they are properly secured. They must not be fixed by striking them with a mallet or any other instrument, neither must they be struck against anything on any pretence whatever.

With rifled M.L. guns the safety-pin will not be withdrawn until after entering the shell into the muzzle.

Examination of Filled Shells.

Remove the fuze-hole plug, pass the "metal hook for removing wads" through the hole in the centre of the wad, and draw the wad out of the fuze-hole; if the powder charge is in a serviceable condition, insert a new papier-mâché wad, and replug the shell as directed in instructions for filling. If the powder charge is found to be caked from the effects of damp, empty the shell and clean it out. If the powder is so caked that it will not run out

of the shell, or if any powder remains adhering to the interior of the shell, fill the shell with boiling water and allow it to stand for about five minutes, then pour out the water and fill up again with boiling water. After standing for 15 minutes more, the shell may be emptied, using the copper scraper for shells to facilitate the removal of the wetted powder. The scraper must not be applied until after 15 minutes have elapsed after the second quantity of boiling water has been poured in. When the shell is perfectly dry, refill with serviceable powder.

If means are available, a wooden horse placed over the open mouth of an empty powder-barrel should be used when emptying shells by up-ending them.

CHARGES.

Silk cloth, 11½ lb., 10½ lb., 9½ lb., 8½ lb., 7½ lb., 7 lb., 6½ lb., 5½ lb., 4½ lb., and 3½ lb., R.L.G.[2]

Cartridges.

	lb.	oz.		lb.	oz.	
Silk cloth, R.M.L. Howitzer, 8-inch of 70 cwt.	11	8, 7	lb., and	3	8	R.L.G.[2] Mark I.

Dimensions.

lb.	oz.	Empty: Length. Inches.	Empty: Breadth. Inches.	Filled: Length. Inches.	Filled: Diameter. Inches.
11	8	14·5	11·4	8·5 to 9	7·5
7	0	11	11·4	6 to 6·5	6·7
3	8	8·26	11·4	4·2 to 4·5	6·1

TUBES.

Friction, Copper, Service, Long (5″).

DIRECTIONS FOR MAKING UP CARTRIDGES.

(See Appendix to Clause 155 A.C., 1883.)

Filling.

Care will be taken to see that the cartridges are properly dry before being filled, and the proper charge will be carefully weighed out and inserted by means of the "Funnel, copper, cartridge." Cartridges will be choked by drawing together the mouth of the cartridge into several plaits with a brass needle, threaded with silk twist doubled; after drawing together the mouth of the cartridge, three turns will be taken round the plaits, and the choke thus formed will be further secured by passing the needle three times through it, alternately above and below the turns, thereby stitching down the turns round the choke at two points equi-distant from each other.

Hooping.

1st. With braid hoops.—Draw the braid through the silk cloth until the knot of the loop comes home to the silk cloth, the single end being already passed through the loop from underneath; pass the single end to one side of and under the loop, then draw the hoop tight and keep it so by placing the forefinger of the left hand firmly on the loop; bring the running end between itself and the loop, and draw tight the single bend thus formed, *taking care that the bend bites on the loop and not on the single end*, otherwise the knot will slip. The maintenance of the proper form of the cartridge depends on the hooping being thus secured.

2nd. With silk twist.—After making the last stitch in choking the needle will be turned downwards and carried through the powder and out at the seam in the line for the front hoop, the silk twist will then be carried tightly round the cartridge so as to form a hoop, and will be stitched to the cartridge at two or three points in the same way as the turns at the choke were secured, and the remainder of the hoops will then be similarly formed.

RANGE TABLES.

(Based on practice of July, September, and December, 1870.)

Projectiles, common, and battering shells, fitted with rotating gas-checks weight, 180 lbs.

Charge, 11½ lb. R.L.G.[2] Muzzle velocity, 956 f.s.

Range.	Drift, right.	Elevation.	Deflection, left.	Angle of descent.	Remaining velocity.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact, vertically or laterally, at each range	50 per cent. of rounds should fall within			Time of flight.
								Length.	Breadth.	Height.	
yds.	yds.	° ′	° ′	° ′	f. s.	yards.	yards.	yards.	yards.	yards.	secs.
300	—	0 44	...	...	935	25·0	0·43	...	...	...	...
400	—	1 4	...	...	928	25·0	0·58	...	...	...	...
500	0·3	1 24	0 2	1 38	921	25·0	0·72	7·0	0·14	0·20	1·6
600	0·4	1 44	0 3	1 56	914	25·0	0·87	8·4	0·18	0·31	1·9
700	0·6	2 4	0 3	2 16	907	25·0	1·01	9·8	0·21	0·43	2·3
800	0·8	2 24	0 3	2 36	900	25·0	1·16	11·2	0·25	0·55	2·6
900	1·0	2 44	0 4	2 56	894	25·0	1·31	12·5	0·28	0·67	3·0
1,000	1·3	3 4	0 5	3 17	888	25·0	1·45	13·8	0·32	0·79	3·3
1,100	1·6	3 24	0 5	3 38	882	25·0	1·60	15·1	0·36	1·00	3·7
1,200	1·9	3 44	0 6	4 0	876	25·0	1·74	16·4	0·40	1·21	4·0
1,300	2·3	4 4	0 7	4 24	870	25·0	1·89	17·7	0·44	1·42	4·4
1,400	2·8	4 24	0 7	4 48	864	23·8	2·03	18·9	0·48	1·63	4·7
1,500	3·3	4 45	0 8	5 12	858	23·8	2·18	20·1	0·52	1·84	5·1
1,600	3·8	5 6	0 9	5 36	852	23·8	2·32	21·3	0·56	2·14	5·4
1,700	4·4	5 27	0 10	6 0	846	23·8	2·47	22·5	0·60	2·44	5·8
1,800	5·0	5 48	0 10	6 25	840	23·8	2·61	23·7	0·64	2·74	6·1
1,900	5·6	6 9	0 10	6 50	834	23·8	2·76	24·9	0·68	3·05	6·5
2,000	6·3	6 30	0 11	7 16	829	23·8	2·91	26·1	0·72	3·36	6·8
2,100	7·1	6 51	0 11	7 44	824	23·8	3·05	27·3	0·77	3·78	7·2
2,200	7·9	7 12	0 12	8 12	819	23·8	3·20	28·5	0·82	4·21	7·5
2,300	8·7	7 33	0 13	8 42	814	23·8	3·34	29·7	0·87	4·64	7·9
2,400	9·5	7 54	0 13	9 12	809	22·7	3·49	30·9	0·92	5·07	8·2
2,500	10·4	8 16	0 14	9 42	804	22·7	3·63	32·1	0·98	5·50	8·6
2,600	11·3	8 38	0 15	10 12	799	21·7	3·78	33·3	1·04	6·08	9·0
2,700	12·3	9 1	0 16	10 42	794	21·7	3·92	34·5	1·10	6·66	9·4
2,800	13·4	9 24	0 16	11 14	789	20·8	4·07	35·7	1·17	7·25	9·8
2,900	14·5	9 48	0 17	11 48	784	20·8	4·21	36·9	1·25	7·84	10·2
3,000	15·7	10 12	0 18	12 24	779	19·2	4·36	38·0	1·33	8·43	10·6
3,100	17·0	10 38	0 19	13 0	775	19·2	4·51	39·1	1·41	9·14	11·0
3,200	18·5	11 4	0 20	13 36	771	19·2	4·65	40·2	1·49	9·85	11·4
3,300	20·1	11 30	0 21	14 12	767	19·2	4·80	41·3	1·57	10·56	11·8
3,400	21·8	11 56	0 22	14 48	763	17·8	4·94	42·4	1·66	11·28	12·2
3,500	23·6	12 24	0 23	15 26	759	17·8	5·09	43·5	1·75	12·00	12·6
3,600	25·5	12 52	0 24	16 6	755	17·8	5·23	44·6	1·85	12·96	13·0
3,700	27·5	13 20	0 25	16 48	751	17·8	5·38	45·7	2·00	13·92	13·4
3,800	29·6	13 48	0 26	17 13	747	16·6	5·52	46·7	2·15	14·88	13·8
3,900	31·8	14 18	0 28	18 14	745	16·6	5·67	47·7	2·30	15·84	14·2
4,000	34·0	14 48	0 29	19 0	739	16·6	5·81	48·6	2·45	16·80	14·7
4,100	36·4	15 18	0 30	19 48	735	16·6	5·96	49·5	2·60	17·96	15·2
4,200	39·0	15 48	0 31	20 36	731	16·6	6·11	50·4	2·80	19·12	15·7
4,300	42·0	16 18	0 33	21 24	727	15·6	6·25	51·3	3·00	20·28	16·2
4,400	45·2	16 50	0 35	22 12	723	15·6	6·40	52·1	3·20	...	16·7
4,500	48·5	17 22	0 37	23 2	720	14·7	6·54	52·9	3·40	...	17·2
4,600	51·5	17 56	0 38	23 54	717	14·7	6·69	53·7	3·35	...	17·7
4,700	55·0	18 30	0 40	24 48	715	13·9	6·84	54·5	3·90	...	18·2
4,800	59·0	19 6	0 42	25 42	713	13·9	6·98	55·3	4·15	...	18·7
4,900	63·0	19 42	0 44	26 36	711	13·9	7·13	56·1	4·40	...	19·2
5,000	67·0	20 18	0 46	27 36	709	13·1	7·27	56·9	4·65	...	19·7
5,100	72·0	20 56	0 48	28 40	708	12·5	7·42	57·7	4·92	...	20·2
5,200	77·0	21 36	0 50	29 46	707	11·9	7·56	58·5	5·19	...	20·7
5,300	82·0	22 18	0 53	30 54	706	11·9	7·71	59·3	5·46	...	21·3
5,400	87·5	23 0	0 55	32 7	705	11·3	7·85	60·1	5·73	...	21·9
5,500	93·0	23 44	0 58	33 24	704	11·3	8·00	60·9	6·00	...	22·5
5,600	99·0	24 28	1 0	34 44	703	11·3	8·14	61·6	6·27	...	23·1
5,700	105·0	25 12	1 3	36 4	704	10·4	8·29	62·3	6·54	...	23·7
5,800	111·5	26 0	1 6	37 24	705	10·0	8·43	63·0	6·82	...	24·3
5,900	118·0	26 50	1 8	38 48	706	9·6	8·58	63·7	7·10	...	25·0
6,000	124·5	27 42	1 11	40 12	707	9·2	8·73	64·4	7·40	...	25·7
6,100	131·0	28 36	1 13	41 36	708	9·2	8·87	65·1	7·70	...	26·4
6,200	137·5	29 30	1 16	43 0	709	9·2	9·02	65·8	8·00	...	27·1
6,300	144·0	30 24	1 18	44 24	710	8·9	9·16	66·4	8·35	...	27·9

Charge, 10½ lb. R.L.G.[2] Muzzle velocity, 920 f.s.

Range.	Drift, right.	Elevation.	Deflection, left.	Angle of descent.	Remaining velocity.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact, vertically or laterally, at each range	50 per cent. of rounds should fall within			Time of flight.
								Length.	Breadth.	Height.	
yards.	yards.	° ′	° ′	° ′	f.s.	yards.	yards.	yards.	yards.	yards.	secs.
300	...	0 46	...	...	899	23·8	0·43	...	...	...	...
400	...	1 7	...	...	893	23·8	0·58	...	...	...	...
500	0·3	1 28	0 2	1 48	887	22·7	0·72	6·6	0·17	0·20	1·6
600	0·5	1 50	0 3	2 12	881	21·7	0·87	7·9	0·21	0·33	1·9
700	0·7	2 13	0 3	2 36	875	21·7	1·01	9·2	0·25	0·46	2·3
800	0·9	2 36	0 4	3 0	869	20·8	1·16	10·5	0·29	0·59	2·6
900	1·2	3 0	0 5	3 24	863	20·8	1·31	11·8	0·33	0·73	3·0
1,000	1·5	3 24	0 5	3 48	857	20·8	1·45	13·1	0·37	0·87	3·3
1,100	1·9	3 48	0 6	4 12	851	20·8	1·60	14·3	0·41	1·09	3·7
1,200	2·3	4 12	0 7	4 36	845	20·8	1·74	15·5	0·45	1·31	4·1
1,300	2·7	4 36	0 7	5 0	839	20·8	1·89	16·7	0·49	1·53	4·5
1,400	3·2	5 0	0 8	5 27	834	20·8	2·03	17·9	0·53	1·75	4·9
1,500	3·8	5 24	0 9	5 54	829	20·8	2·18	19·1	0·57	1·98	5·2
1,600	4·5	5 48	0 10	6 21	823	20·8	2·32	20·3	0·62	2·31	5·6
1,700	5·2	6 12	0 11	6 48	817	20·8	2·47	21·5	0·67	2·64	5·9
1,800	5·9	6 36	0 11	7 18	812	20·8	2·61	22·7	0·72	2·97	6·3
1,900	6·7	7 0	0 12	7 48	807	20·8	2·76	23·9	0·77	3·30	6·7
2,000	7·6	7 24	0 13	8 18	802	20·8	2·91	25·0	0·82	3·64	7·1
2,100	8·5	7 48	0 14	8 48	797	20·8	3·05	26·1	0·87	4·09	7·5
2,200	9·5	8 12	0 15	9 18	792	20·8	3·20	27·2	0·93	4·54	7·9
2,300	10·5	8 36	0 16	9 51	787	20·8	3·34	28·3	0·99	4·99	8·3
2,400	11·5	9 0	0 17	10 24	782	20·8	3·49	29·4	1·05	5·44	8·7
2,500	12·7	9 24	0 18	10 57	777	20·8	3·63	30·5	1·12	5·90	9·1
2,600	13·9	9 48	0 18	11 30	772	20·8	3·78	31·6	1·19	6·49	9·5
2,700	15·2	10 12	0 19	12 3	767	20·8	3·92	32·7	1·26	7·08	9·9
2,800	16·5	10 36	0 20	12 36	762	20·8	4·07	33·8	1·34	7·68	10·3
2,900	18·0	11 0	0 21	13 12	758	19·2	4·21	34·9	1·42	8·28	10·7
3,000	19·5	11 26	0 22	13 48	754	17·8	4·36	36·0	2·51	8·88	11·1
3,100	21·0	11 54	0 23	14 24	750	16·6	4·51	37·1	1·60	9·63	11·5
3,200	22·5	12 24	0 24	15 0	746	16·6	4·65	38·1	1·70	10·38	11·9
3,300	24·0	12 54	0 25	15 36	742	16·6	4·80	39·1	1·80	11·13	12·4
3,400	25·5	13 24	0 26	16 18	738	16·1	4·94	40·1	1·91	11·88	12·9
3,500	27·5	13 55	0 27	17 0	734	15·6	5·09	41·1	2·02	12·63	13·4
3,600	29·5	14 27	0 28	17 42	730	14·7	5·23	42·1	2·15	13·62	13·9
3,700	31·5	15 1	0 29	18 27	726	14·3	5·38	43·1	2·28	14·61	14·4
3,800	33·5	15 36	0 30	19 12	722	13·9	5·52	44·1	2·42	15·60	14·9
3,900	36·0	16 12	0 32	20 0	718	13·9	5·67	45·1	2·56	16·60	15·4
4,000	38·5	16 48	0 33	20 48	714	13·9	5·81	46·1	2·70	17·60	15·9
4,100	41·0	17 24	0 34	21 36	710	13·9	5·96	47·1	2·85	18·86	16·4
4,200	43·5	18 0	0 36	22 24	707	13·9	6·11	48·0	3·01	20·12	16·9
4,300	46·5	18 36	0 37	23 18	704	13·9	6·25	48·9	3·18	...	17·4
4,400	49·5	19 12	0 39	24 12	701	13·9	6·40	49·8	3·36	...	17·9
4,500	52·2	19 48	0 40	25 6	698	13·9	6·54	50·7	3·55	...	18·5
4,600	55·5	20 4	0 41	26 0	695	13·1	6·69	51·6	3·75	...	19·1
4,700	59·0	21 2	0 43	26 54	692	13·1	6·84	52·5	3·89	...	19·7
4,800	63·0	21 40	0 45	27 54	689	12·5	6·98	53·4	4·23	...	20·3
4,900	67·0	22 20	0 47	28 54	686	12·5	7·13	54·3	4·48	...	20·9
5,000	71·0	23 0	0 49	29 54	684	11·3	7·27	55·2	4·74	...	21·5
5,100	75·0	23 44	0 51	31 0	682	10·8	7·42	56·0	5·00	...	22·1
5,200	80·0	24 30	0 53	32 6	680	10·4	7·56	56·8	5·28	...	22·7
5,300	85·0	25 18	0 55	33 16	679	10·0	7·71	57·6	5·56	...	23·4
5,400	90·5	26 8	0 58	34 30	678	10·0	7·85	58·4	5·84	...	24·1
5,500	96·5	26 58	1 0	35 48	677	9·6	8·00	59·2	6·12	...	24·8
5,600	103·0	27 50	1 3	37 12	677	9·6	8·14	59·9	6·40	...	25·5
5,700	109·5	28 42	1 6	38 42	678	9·2	8·29	60·6	6·69	...	26·2
5,800	116·0	29 36	1 9	40 12	679	8·3	8·43	61·3	6·98	...	26·9
5,900	122·5	30 36	1 11	41 57	680	8·3	8·58	62·0	7·27	...	27·7

Charge, 9½ lb. R.L.G.[2] Muzzle velocity, 875 f.s.

Range.	Drift, right.	Elevation.	Deflection, left.	Angle of descent.	Remaining velocity.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact, vertically or laterally, at each range	50 per cent. of rounds should fall within			Time of flight.
								Length.	Breadth.	Height.	
yards.	yards.	° ′	° ′	° ′	yards.	yards.	yards.	yards.	yards.	yards.	secs.
300	...	0 48	...	...	857	20·8	0·43	...	...	..	...
400	...	1 12	...	...	851	20·0	0·58	...	...	...	...
500	0·4	1 37	0 3	2 9	845	19·2	0·72	6·2	0·20	0·23	1·6
600	0·6	2 3	0 3	2 36	839	18·5	0·87	7·5	0·24	0·37	1·9
700	0·8	2 30	0 4	3 3	833	18·5	1·01	8·7	0·28	0·51	2·3
800	1·1	2 57	0 5	3 30	828	18·5	1·16	9·9	0·32	0·65	2·6
900	1·5	3 24	0 6	3 57	823	18·5	1·31	11·1	0·36	0·80	3·0
1,000	1·9	3 51	0 7	4 24	818	18·5	1·45	12·3	0·40	0·95	3·4
1,100	2·3	4 18	0 7	4 51	812	18·5	1·60	13·5	0·45	1·19	3·8
1,200	2·9	4 45	0 8	5 18	807	18·5	1·74	14·7	0·50	1·44	4·2
1,300	3·5	5 12	0 9	5 48	802	18·5	1·89	15·9	0·55	1·69	4·6
1,400	4·1	5 39	0 10	5 18	797	18·5	2·03	17·0	0·60	1·94	5·0
1,500	4·8	6 6	0 11	6 48	792	18·5	2·18	18·1	0·65	2·19	5·4
1,600	5·6	6 33	0 12	7 18	787	18·5	2·32	19·2	0·70	2·52	5·8
1,700	6·5	7 0	0 13	7 48	782	17·8	2·47	20·3	0·75	2·86	6·2
1,800	7·5	7 28	0 14	8 18	777	17·8	2·61	21·4	0·80	3·20	6·6
1,900	8·5	7 56	0 15	8 48	772	17·8	2·76	22·5	0·86	3·54	7·0
2,000	9·5	8 24	0 16	9 18	767	17·8	2·91	23·6	0·92	3·88	7·4
2,100	10·5	8 52	0 17	9 51	762	17·8	3·05	24·7	0·98	4·36	7·8
2,200	11·5	9 20	0 18	10 24	757	17·8	3·20	25·8	1·04	4·84	8·2
2,300	12·5	9 48	0 19	11 0	752	17·8	3·34	26·9	1·10	5·33	8·6
2,400	14·0	10 16	0 20	11 36	747	17·8	3·49	28·0	1·17	5·82	9·1
2,500	15·5	10 44	0 21	12 12	742	16·6	3·63	29·0	1·25	6·31	9·6
2,600	17·0	11 14	0 22	12 48	737	16·6	3·78	30·0	1·33	6·91	10·1
2,700	18·5	11 44	0 23	13 24	732	16·6	3·92	31·0	1·41	7·32	10·6
2,800	20·0	12 14	0 24	14 0	727	15·6	4·07	32·0	1·50	7·83	11·1
2,900	21·5	12 46	0 25	14 36	723	15·6	4·21	33·0	1·59	8·34	11·6
3,000	23·0	13 18	0 26	15 15	719	15·6	4·36	34·0	1·69	9·35	12·1
3,100	24·5	13 50	0 27	15 54	715	14·7	4·51	35·0	1·79	10·13	12·6
3,200	26·5	14 24	0 28	16 36	711	14·7	4·65	36·0	1·90	10·91	13·1
3,300	28·5	14 58	0 30	17 18	707	14·7	4·80	36·9	2·01	11·69	13·6
3,400	30·5	15 32	0 31	18 0	703	14·7	4·94	37·8	2·12	12·47	14·1
3,500	32·5	16 6	0 32	18 42	699	13·9	5·09	38·7	2·24	13·25	14·6
3,600	34·5	16 42	0 33	19 26	695	13·9	5·23	39·6	2·39	14·14	15·1
3,700	36·7	17 18	0 34	20 12	691	13·9	5·38	40·5	2·54	15·03	15·6
3,800	39·0	17 54	0 35	21 0	687	13·9	5·52	41·4	2·69	15·92	16·1
3,900	41·5	18 30	0 37	21 48	683	13·1	5·67	42·3	2·84	16·81	16·7
4,000	44·0	19 8	0 38	22 36	680	13·1	5·81	43·2	3·00	17·70	17·3
4,100	47·0	19 46	0 39	23 30	677	13·1	5·96	44·1	3·16	19·04	17·9
4,200	50·0	20 24	0 41	24 24	674	13·1	6·11	45·0	3·32	20·38	18·5
4,300	53·0	21 2	0 42	25 18	671	12·5	6·25	45·8	3·49	...	19·1
4,400	56·5	21 42	0 44	26 12	668	12·5	6·50	46·6	3·66	...	19·7
4,500	60·0	22 22	0 46	27 6	665	12·5	6·54	47·4	3·84	...	20·3
4,600	60·4	23 2	0 48	28 0	662	12·5	6·69	48·2	4·02	...	20·9
4,700	68·0	23 42	0 50	29 0	659	11·9	6·84	49·0	4·21	...	21·5
4,800	72·5	24 24	0 52	30 0	656	11·9	6·98	49·8	4·41	...	22·2
4,900	77·0	25 6	0 54	31 0	653	11·9	7·13	50·6	4·63	...	22·9
5,000	81·5	25 48	0 56	32 6	650	11·3	7·27	51·4	4·87	...	23·6
5,100	86·0	26 32	0 58	33 12	648	11·3	7·42	52·1	5·15	...	24·3
5,200	91·0	27 16	1 0	34 34	647	10·8	7·56	52·8	5·43	...	25·0
5,300	96·0	28 2	1 2	35 36	646	10·8	7·71	53·5	5·71	...	25·8
5,400	101·0	28 48	1 4	36 48	645	10·4	7·85	54·2	5·99	...	26·6
5,500	106·0	29 36	1 6	38 0	644	10·4	8·00	54·9	6·27	...	27·4
	111·0	30 24	1 8	39 24	643	10·4	8·14	55·6	6·55	...	28·2

Charge, 8½ lb. R.L.G.[2] Muzzle velocity, 825 f.s.

Range.	Drift, right.	Elevation.	Deflection, left.	Angle of descent.	Remaining velocity.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact, vertically or laterally, at each range	50 per cent. of rounds should fall within			Time of flight.
								Length.	Breadth.	Height.	
yards.	yards.	° ′	° ′	° ′	f.s.	yards.	yards.	yards.	yards.	yards.	secs.
300	...	0 54	...	...	808	16·6	0·43	...	...	...	...
400	...	1 24	...	...	803	16·6	0·58	...	...	...	...
500	0·5	1 24	0 3	2 30	798	16·6	0·72	5·9	0·22	0·26	1·7
600	0·8	2 24	0 5	3 0	793	16·6	0·87	7·1	0·27	0·41	2·0
700	1·2	2 54	0 6	3 30	788	16·6	1·01	8·3	0·32	0·56	2·3
800	1·6	3 24	0 7	4 0	783	16·6	1·16	9·4	0·37	0·71	2·6
900	2·0	3 54	0 8	4 30	778	16·6	1·31	10·5	0·42	0·87	3·0
1,000	2·5	4 24	0 9	5 3	773	16·6	1·45	11·6	0·47	1·03	3·4
1,100	3·0	4 54	0 9	5 36	768	16·6	1·60	12·7	0·52	1·30	3·8
1,200	3·6	5 24	0 10	6 9	763	16·6	1·74	13·8	0·57	1·57	4·2
1,300	4·3	5 54	0 11	6 42	758	16·6	1·89	14·9	0·62	1·84	4·6
1,400	5·1	6 25	0 13	7 12	753	16·6	2·03	16·0	0·67	2·11	5·0
1,500	6·0	6 56	0 14	7 48	749	15·6	2·18	17·1	0·72	2·38	5·4
1,600	7·0	7 28	0 15	8 24	744	15·6	2·32	18·2	0·78	2·69	5·8
1,700	8·0	8 0	0 16	9 0	739	15·4	2·47	19·3	0·84	3·00	6·2
1,800	9·0	8 33	0 17	9 36	734	15·4	2·61	20·4	0·90	3·31	6·7
1,900	10·0	9 6	0 18	10 12	729	15·4	2·76	21·4	0·96	3·62	7·2
2,000	11·2	9 39	0 19	10 48	725	15·4	2·91	22·4	1·02	3·93	7·7
2,100	12·5	10 12	0 20	11 30	720	14·7	3·05	23·4	1·08	4·56	8·2
2,200	13·8	10 46	0 22	12 12	716	14·7	3·20	24·4	1·15	5·19	8·7
2,300	15·2	11 20	0 23	12 44	712	14·7	3·34	25·4	1·22	5·82	9·2
2,400	16·7	11 54	0 24	13 36	708	13·9	3·49	26·4	1·30	6·46	9·7
2,500	18·3	12 30	0 25	14 18	704	13·9	3·63	27·4	1·38	7·10	10·2
2,600	20·0	13 6	0 26	15 0	700	13·1	3·78	28·4	1·47	7·80	10·7
2,700	21·7	13 44	0 28	15 45	696	12·5	3·92	29·3	1·56	8·50	11·2
2,800	23·5	14 24	0 29	16 30	692	11·9	4·07	30·2	1·66	9·20	11·7
2,900	25·5	15 6	0 30	17 20	688	11·9	4·21	31·1	1·76	9·90	12·2
3,000	27·5	15 48	0 31	18 10	684	11·3	4·36	32·0	1·87	10·60	12·8
3,100	29·5	16 32	0 33	19 0	680	10·8	4·51	32·9	1·98	11·54	13·4
3,200	31·5	17 18	0 34	19 54	676	10·8	4·65	33·8	2·10	12·48	14·0
3,300	33·5	18 4	0 35	20 48	672	10·8	4·80	34·7	2·22	13·42	14·6
3,400	36·0	18 50	0 36	21 42	668	10·4	4·94	35·5	2·35	14·36	15·2
3,500	38·5	19 38	0 38	22 36	664	10·4	5·09	36·3	2·50	15·30	15·8
3,600	41·0	20 26	0 39	23 36	661	10·0	5·23	37·1	2·66	16·52	16·4
3,700	43·7	21 16	0 41	24 36	658	9·6	5·38	37·9	2·82	17·74	17·0
3,800	46·5	22 8	0 42	25 40	655	9·6	5·52	38·7	2·98	18·96	17·6
3,900	49·5	23 0	0 44	26 46	652	9·2	5·67	39·5	3·14	20·18	18·2
4,000	52·5	23 54	0 45	27 56	649	9·2	5·81	40·3	3·30	...	18·9
4,100	56·0	24 48	0 47	29 12	647	8·9	5·96	41·1	3·47	...	19·6
4,200	59·5	29 44	0 49	30 36	645	8·6	6·11	41·9	3·65	...	20·3
4,300	63·0	26 42	0 50	32 0	644	8·3	6·25	42·7	3·83	...	21·0
4,400	66·5	27 42	0 52	33 42	643	8·3	6·40	43·5	4·02	...	21·7
4,500	70·5	28 42	0 54	35 24	642	8·3	6·54	44·3	4·21	...	22·4
4,600	74·5	29 42	0 56	37 9	641	8·3	6·69	45·1	4·41	...	23·2

Charge, 7¼ lb. R.L.G.[2] Muzzle velocity, 770 f.s.

Range.	Drift, range.	Elevation.	Deflection, left.	Angle of descent.	Remaining velocity.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact, vertically or laterally, at each range	50 per cent. of rounds should fall within			Time of flight.
								Length.	Breadth.	Height.	
yards.	yards.	° ′	° ′	° ′	f.s.	yards.	yards.	yards.	yards.	yards.	secs.
300	...	1 0	...	...	755	13·9	0·43	...	...	...	...
400	...	1 36	...	...	750	13·9	0·58	...	...	...	...
500	0·7	2 12	0 5	2 58	746	13·9	0·72	5·6	0·24	0·28	1·8
600	1·2	2 48	0 7	3 32	741	13·9	0·87	6·7	0·29	0·45	2·1
700	1·7	3 24	0 8	4 6	736	13·9	1·01	7·8	0·34	0·62	2·5
800	2·2	4 0	0 9	4 42	731	13·9	1·16	8·9	0·39	0·79	2·9
900	2·7	4 36	0 10	5 18	727	13·9	1·31	10·0	0·44	0·96	3·3
1,000	3·3	5 12	0 11	5 54	723	13·9	1·45	11·1	0·49	1·14	3·7
1,100	4·0	5 48	0 13	6 30	718	13·9	1·60	12·2	0·55	1·39	4·1
1,200	4·8	6 24	0 14	7 6	713	13·9	1·74	13·2	0·61	1·64	4·5
1,300	5·7	7 0	0 15	7 45	708	13·9	1·89	14·2	0·67	1·89	4·9
1,400	6·7	7 36	0 17	8 24	704	13·9	2·03	15·2	0·73	2·14	5·3
1,500	7·7	8 12	0 18	9 3	700	13·9	2·18	16·2	0·79	2·40	5·7
1,600	8·8	8 48	0 19	9 42	695	13·9	2·32	17·2	0·85	2·86	6·2
1,700	10·0	9 24	0 20	10 24	690	13·9	2·47	18·2	0·91	3·32	6·7
1,800	11·5	10 0	0 22	11 6	686	13·9	2·61	19·2	0·98	3·78	7·2
1,900	13·0	10 36	0 24	11 48	682	13·9	2·76	20·2	1·05	4·25	7·7
2,000	14·5	11 12	0 25	12 30	678	13·1	2·91	21·2	1·12	4·72	8·2
2,100	16·0	11 50	0 26	13 15	673	13·1	3·05	22·2	1·19	5·30	8·7
2,200	17·5	12 28	0 27	14 0	669	12·5	3·20	23·1	1·26	5·88	9·2
2,300	19·2	13 8	0 29	14 48	665	12·5	3·34	24·0	1·34	6·46	9·7
2,400	21·0	13 48	0 30	15 36	661	12·5	3·49	24·0	1·42	7·04	10·3
2,500	23·0	14 18	0 32	16 24	657	11·9	3·63	24·9	1·51	7·63	10·9
2,600	25·0	15 0	0 33	17 12	653	11·3	3·78	25·8	1·61	8·38	11·5
2,700	27·0	15 44	0 34	18 3	649	10·8	3·92	26·7	1·71	9·13	12·1
2,800	29·0	16 30	0 36	18 54	645	10·8	4·07	27·6	1·82	9·88	12·7
2,900	31·0	17 16	0 37	19 48	641	10·8	4·21	28·4	1·93	10·64	13·3
3,000	33·2	18 2	0 38	20 42	637	10·4	4·36	29·2	2·04	11·40	13·9
3,100	35·5	18 50	0 39	21 36	633	9·6	4·51	30·0	2·16	12·40	14·5
3,200	38·0	19 42	0 41	22 26	629	9·2	4·65	31·6	2·29	13·40	15·2
3,300	40·5	20 36	0 42	23 36	626	9·2	4·80	32·4	2·42	14·40	15·9
3,400	43·0	21 30	0 44	24 36	623	9·2	4·94	33·2	2·55	15·40	16·6
3,500	45·5	22 24	0 45	25 36	620	9·2	5·09	34·0	2·70	16·40	17·3
3,600	48·5	23 18	0 46	26 42	617	8·9	5·23	34·8	2·86	17·84	18·0
3,700	51·5	24 14	0 48	27 54	615	8·6	5·38	35·6	3·04	19·28	18·7
3,800	54·5	25 12	0 49	29 6	613	8·3	5·52	36·4	3·22	20·72	19·4
3,900	58·0	26 12	0 51	30 18	611	8·3	5·67	37·2	3·41	...	20·2
4,000	61·5	27 12	0 53	31 42	609	8·0	5·81	38·0	3·60	...	21·0
4,100	65·5	28 14	0 55	33 12	607	7·8	5·96	38·8	3·80	...	21·8
4,200	69·5	29 18	0 57	34 48	605	7·8	6·11	39·6	4·00	...	22·6
4,300	74·0	30 24	1 0	36 46	603	7·8	6·25	40·4	4·21	...	23·5

Charge, 7 lb. R.L.G.[2] Muzzle velocity, 715 f.s.

Range.	Drift, right.	Elevation.	Deflection, left.	Angle of descent.	Remaining velocity.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact, vertically or laterally, at each range	50 per cent. of rounds should fall within			Time of flight.
								Length.	Breadth.	Height.	
yards.	yards.	° ′	° ′	° ′	f.s.	yards.	yards.	yards.	yards.	yards.	secs.
300	...	1 20	...	...	700	13·9	0·43	...	...	...	...
400	...	1 56	...	...	695	13·9	0·58	...	...	...	...
500	0·8	2 32	0 6	3 0	690	13·9	0·72	6·4	0·27	0·29	1·8
600	1·2	3 8	0 7	3 36	686	13·1	0·87	6·4	0·33	0·36	2·2
700	1·7	3 46	0 8	4 12	682	13·1	1·01	7·4	0·39	0·43	2·6
800	2·3	4 24	0 10	4 54	678	13·1	1·16	8·4	0·45	0·50	3·0
900	3·0	5 2	0 11	5 36	674	13·1	1·31	9·4	0·51	0·98	3·4
1,000	3·8	5 40	0 13	6 18	670	13·1	1·45	10·4	0·57	1·16	3·8
1,110	4·7	6 18	0 15	7 0	666	13·1	1·60	11·4	0·63	1·46	4·2
1,200	5·7	6 56	0 16	7 42	662	13·1	1·74	12·4	0·69	1·77	4·6
1,300	6·8	7 34	0 18	8 24	658	13·1	1·89	13·4	0 76	2·08	5·1
1,400	8·0	8 12	0 19	9 9	654	12·5	2·03	14·4	0·82	2·39	5·6
1,500	9·2	8 52	0 21	9 54	650	12·5	2·18	15·4	0·88	2·70	6·1
1,600	10·5	9 32	0 22	10 42	646	12·5	2·32	16·4	0·94	3·16	6·6
1,700	11·9	10 12	0 24	11 30	642	12 5	2·47	17·3	1·01	3·62	7·1
1,800	13·3	10 52	0 25	12 18	638	12·5	2·61	18·2	1·08	4·08	7·6
1,900	14·8	11 32	0 27	13 6	934	12·5	2·76	19·1	1·15	4·54	8·1
2,000	16·4	12 12	0 28	14 0	631	12·5	2·91	20·0	1·22	5·00	8·6
2,100	18·1	12 52	0 30	14 54	628	12·5	3·05	20·9	1·30	5·66	9·1
2,200	19·8	13 32	0 31	15 48	625	12·5	3·20	21·8	1·38	6·32	9·6
2.300	21·6	14 12	0 33	16 42	622	11·3	3·34	22·7	1·46	6·98	10·2
2,400	23·5	14 56	0 34	17 42	619	10·8	3·49	23·6	1·54	7·65	10·8
2,500	25·5	15 42	0 35	18 42	616	10·4	3·63	24·5	1·63	8·32	11·4
2,600	27·5	16 30	0 36	19 42	613	10·4	3·78	25·4	1·72	9·08	12·0
2,700	29·7	17 18	0 37	20 42	610	10·4	3·92	26·3	1·81	9·84	12·6
2,800	32·0	18 6	0 39	21 48	607	9·2	4·07	27·2	1·91	10·60	13·3
2,900	34·3	19 0	0 40	22 54	604	9·2	4·21	28·0	2·02	11·36	14·0
3,000	37·0	19 54	0 42	24 6	601	8·9	4·36	28·8	2·13	12·13	14·7
3,100	39·7	20 50	0 44	25 18	598	8·3	4·51	29·6	2·24	13·62	15·4
3,200	42·5	21 50	0 45	26 36	595	7·8	4·65	30·4	2·37	15·11	16·1
3,300	45·5	22 54	0 47	27 57	592	7·5	4·80	31·2	2·50	16·60	16·8
3,400	48·7	24 0	0 49	29 18	590	6 9	4·94	32·0	2·65	18·10	17·5
3,500	52·0	25 12	0 51	30 48	588	6·9	5·09	32·8	2·80	19·60	18·3
3,600	56·0	26 54	0 53	32 24	587	6·7	5·23	33·6	2·95	...	19·1
3,700	60·0	27 38	0 55	34 12	588	6·0	5·38	34·4	3·12	...	19·9
3,800	64·0	29 0	0 58	36 12	589	5·9	5·52	35·2	3·32	...	20·7
3,900	68·5	30 24	1 0	38 30	590	5·8	5·67	36·0	3·52	...	21·5

Charge, 6½ lb. R.L.G.[2] Muzzle velocity, 710 f.s.

Range.	Drift, right.	Elevation.	Deflection, left.	Angle of descent.	Remaining velocity.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact, vertically or laterally at each range.	50 per cent. of rounds should fall within			Time of flight.
								Length.	Breadth.	Height.	
yards.	yards.	° ′	° ′	° ′	f.s.	yards.	yards.	yards.	yards.	yards.	secs.
300	...	1 24	...	...	696	12·5	0·43	...	...	...	...
400	...	2 4	...	...	692	12·5	0·58	...	...	...	...
500	0·9	2 44	0 6	3 22	688	12·2	0·72	5·2	0·30	0·30	1·9
600	1·5	3 25	0 9	4 4	684	12·2	0·87	6·2	0·36	0·48	2·3
700	2·1	4 6	0 10	4 46	680	11·9	1·01	7·2	0·42	0·67	2·7
800	2·8	4 48	0 12	5 30	676	11·9	1·16	8·2	0·48	0·86	3·1
900	3·6	5 30	0 14	6 14	672	11·9	1·31	9·2	0·54	1·05	3·5
1,000	4·5	6 12	0 16	6 58	668	11·9	1·45	10·1	0·60	1·24	3·9
1,100	5·5	6 54	0 17	7 42	664	11·9	1·60	11·0	0·67	1·54	4·3
1,200	6·5	7 36	0 19	8 27	660	11·9	1·74	11·9	0·74	1·84	4·8
1,300	7·5	8 18	0 20	9 12	656	11·9	1·89	12·8	0·81	2·14	5·3
1,400	8·5	9 0	0 21	9 57	652	11·9	2·03	13·7	0·88	2·45	5·8
1,500	9·8	9 42	0 22	10 42	648	11·9	2·18	14·6	0·95	2·76	6·3
1,600	11·2	10 24	0 24	11 33	644	11·9	2·32	15·5	1·02	3·23	6·8
1,700	12·7	11 6	0 26	12 24	640	11·9	2·47	16·4	1·09	3·70	7·3
1,800	14·4	11 48	0 28	13 15	636	11·6	2·61	17·3	1·16	4·17	7·8
1,900	16·2	12 31	0 29	14 6	632	11·6	2·76	18·2	1·24	4·64	8·4
2,000	18·0	13 14	0 31	15 0	628	11·6	2·91	19·1	1·32	5·11	9·0
2,100	19·8	13 57	0 32	15 54	624	11·6	3·05	19·9	1·40	5·76	9·6
2,200	21·7	14 40	0 34	16 48	620	11·3	3·20	20·7	1·49	6·42	10·2
2,300	23·7	15 24	0 35	17 42	616	10·8	3·34	21·5	1·58	7·08	10·8
2,400	25·7	16 10	0 37	18 42	612	10·0	3·49	22·3	1·67	7·74	11·4
2,500	28·0	17 0	0 39	19 42	608	9·6	3·63	23·1	1·76	8·40	12·0
2,600	30·5	17 52	0 40	20 42	604	8·9	3·78	23·9	1·86	9·29	12·7
2,700	33·5	18 48	0 42	21 48	601	8·6	3·92	24·7	1·96	10·18	13·4
2,800	35·5	19 46	0 44	22 54	598	8·3	4·07	25·5	2·06	11·07	14·1
2,900	38·0	20 46	0 45	24 0	565	8·0	4·21	26·3	2·17	11·96	14·8
3,000	40·7	21 48	0 47	25 12	592	7·6	4·36	27·1	2·28	12·85	15·5
3,100	43·7	22 54	0 48	26 30	590	6·7	4·51	27·9	2·40	14·44	16·2
3,200	46·7	24 8	0 50	27 54	588	6·5	4·65	28·6	2·52	16·03	16·9
3,300	49·7	25 24	0 52	29 24	586	6·4	4·80	29·3	2·65	17·62	17·7
3,400	53·0	26 42	0 54	31 0	584	5·8	4·94	30·0	2·79	19·21	18·5
3,500	56·5	28 8	0 56	33 0	582	5·6	5·09	30·7	2·94	20·80	19·3
3,600	60·5	29 36	0 58	35 24	581	5·2	5·23	31·4	3·09	...	20·2

Charge, 5½ lb. R.L.G.[2] Muzzle velocity, 641 f.s.

300	...	1 48	...	...	629	10·8	0·43	...	...	...	...
400	...	2 34	...	...	625	10·6	0·58	...	...	...	...
500	1·3	3 20	0 9	3 49	621	10·8	0·72	4·7	0·36	0·31	2·2
600	2·1	4 6	0 12	4 36	617	10·4	0·87	5·6	0·43	0·50	2·7
700	2·9	4 54	0 14	5 30	613	10·0	1·01	6·5	0·50	0·70	3·1
800	3·7	5 44	0 16	6 24	609	9·6	1·16	7·4	0·57	0·90	3·7
900	4·7	6 36	0 18	7 18	605	9·6	1·31	8·2	0·64	1·10	4·2
1,000	5·7	7 28	0 20	8 12	601	9·6	1·45	9·0	0·71	1·30	4·7
1,100	7·0	8 20	0 22	9 6	597	9·6	1·60	9·8	0·79	1·65	5·2
1,200	8·5	9 12	0 24	10 6	593	9·2	1·74	10·6	0·87	2·00	5·7
1,300	10·0	10 6	0 26	11 6	589	9·2	1·89	11·4	0·95	2·35	6·2
1,400	11·5	11 0	0 28	12 6	585	9·2	2·03	12·2	1·03	2·70	6·7
1,500	13·2	11 54	0 30	13 12	582	9·2	2·18	13·0	1·11	3·06	7·3
1,600	15·0	12 48	0 32	14 18	579	9·2	2·32	13·8	1·19	3·61	7·9
1,700	17·0	13 42	0 34	15 24	576	9·2	2·47	14·6	1·27	4·16	8·5
1,800	19·0	14 36	0 36	16 36	573	9·2	2·61	15·4	1·35	4·71	9·1
1,900	21·0	15 30	0 38	17 48	570	9·2	2·76	16·2	1·43	5·27	9·7
2,000	23·2	16 24	0 40	19 0	567	9·2	2·91	17·0	1·52	5·83	10·3
2,100	25·5	17 18	0 42	20 18	564	9·2	3·05	17·8	1·61	6·68	10·9
2,200	28·0	18 12	0 44	21 36	561	9·2	3·20	18·5	1·70	7·53	11·5
2,300	30·5	19 6	0 46	23 0	558	8·3	3·34	19·2	1·79	8·38	12·2
2,400	33·0	20 6	0 47	24 24	556	7·6	3·49	19·9	1·88	9·24	12·9
2,500	35·7	21 12	0 49	25 54	554	5·9	3·63	20·6	1·96	10·10	13·6
2,600	38·4	22 36	0 51	27 30	555	5·9	3·78	21·3	2·06	11·70	14·3
2,700	41·2	24 0	0 53	29 18	556	5·2	3·92	22·0	2·15	13·30	15·0
2,800	44·2	25 36	0 54	31 18	557	5·2	4·07	22·7	2·24	14·90	15·7
2,900	47·2	27 12	0 56	33 36	559	4·6	4·21	23·4	2·34	16·50	16·4
3,000	50·2	29 0	0 58	36 42	561	4·6	4·36	24·1	2·44	18·10	17·1

Charge, 4½ lb. R.L.G.[2] Muzzle velocity, 556 f.s.

Range.	Drift, right.	Elevation.	Deflection, left.	Angle of descent.	Remaining velocity.	Five minutes' elevation increases or decreases the range by	Five minutes will alter point of impact vertically, or laterally, at each range	50 per cent. of rounds should fall within			Time of flight.
								Length.	Breadth.	Height.	
yards.	yards.	° ′	° ′	° ′	f.s.	yards.	yards.	yards.	yards.	yards.	secs.
300	...	2 36	...	...	544	9·2	0·43	...	...	...	...
400	...	3 30	...	...	540	9·2	0·58	...	...	...	...
500	1·9	4 24	0 13	4 36	537	8·9	0·72	4·2	0·41	0·34	2·6
600	2·7	5 20	0 15	5 42	534	8·6	0·87	5·0	0·50	0·55	3·2
700	3·6	6 10	0 18	6 48	531	8·0	1·01	5·8	0·58	0·76	3·8
800	4·7	7 20	0 20	7 54	528	7·8	1·16	6·5	0·66	0·98	4·4
900	6·0	8 24	0 23	9 0	525	7·5	1·31	7·2	0·75	1·20	5·0
1,000	7·5	9 30	0 26	10 12	522	7·3	1·45	7·9	0·83	1·42	5·6
1,100	9·3	10 38	0 29	11 30	519	7·1	1·60	8·6	0·92	1·82	6·2
1,200	11·2	11 48	0 32	12 48	516	6·9	1·74	9·3	1·00	2·22	6·8
1,300	13·4	13 0	0 35	14 6	513	6·7	1·89	10·0	1·08	2·63	7·4
1,400	15·8	14 14	0 39	15 30	510	6·5	2·03	10·7	1·17	3·04	8·1
1,500	18·3	15 30	0 42	16 54	507	6·4	2·18	11·4	1·26	3·45	8·8
1,600	21·1	16 48	0 45	18 24	504	6·0	2·32	12·1	1·35	4·15	9·5
1,700	24·2	18 10	0 49	19 54	501	5·9	2·47	12·8	1·44	4·85	10·2
1,800	27·4	19 34	0 52	21 30	498	5·8	2·61	13·5	1·53	5·56	11·0
1,900	30·8	21 0	0 56	23 12	495	5·5	2·76	14·2	1·62	6·27	11·8
2,000	34·5	22 30	0 59	25 0	493	5·4	2·91	14·9	1·71	6·98	12·6
2,100	38·4	24 2	1 3	26 48	491	5·3	3·06	15·6	1·80	8·11	13·4
2,200	42·4	25 36	1 6	28 42	489	5·2	3·20	16·3	1·89	9·24	14·3
2,300	46·6	27 12	1 10	30 48	487	4·8	3·34	16·9	1·98	10·37	15·2
2,400	51·4	28 56	1 14	32 12	486	4·7	3·49	17·5	2·07	11·50	16·2

Charge, 3½ lb. R.L.G.[2] Muzzle velocity, 473 f.s.

300	...	3 12	...	...	464	6·0	0·43	...	...	...	...
400	...	4 30	...	...	460	6·0	0·68	...	...	...	...
500	2·2	5 50	0 15	6 54	457	6·0	0·72	8·2	0·55	1·0	3.2
600	3·0	7 12	0 17	8 18	454	5·8	0·87	10·1	0·67	1·5	3·9
700	3·9	8 38	0 19	9 42	451	5·7	1·01	11·9	0·80	2·0	4·6
800	5·1	10 6	0 22	11 6	448	5·5	1·16	13·8	0·93	2·7	5·3
900	6·3	11 36	0 24	12 30	445	5·3	1·31	15·7	1·06	3·5	6·0
1,000	7·7	13 10	0 26	14 6	442	5·1	1·45	17·6	1·20	4·4	6·8
1,100	9·4	14 48	0 29	15 48	440	4·7	1·60	19·6	1·35	5·5	7·6
1,200	11·4	16 33	0 33	17 30	438	4·6	1·74	21·7	1·50	6·9	8·4
1,300	13·5	18 21	0 36	19 18	436	4·4	2·89	23·8	1·66	8·4	9·2
1,400	16·0	20 15	0 39	21 18	434	4·2	2·03	25·9	1·83	10·1	10·0
1,500	19·0	22 15	0 43	23 30	432	4·0	2·18	28·1	2·00	12·3	10·9
1,600	22·3	24 21	0 48	26 0	433	3·6	2·32	30·4	2·18	14·9	11·8
1,700	27·0	26 38	0 54	28 42	434	3·1	2·47	32·9	2·37	18·0	12·8
1,800	34·0	29 18	1 5	32 6	435	2·7	2·61	35·4	2·57	22·4	13·8
1,900	42·2	32 24	1 16	37 37	436	2·1	2·76	38·2	2·80	29·4	14·9

Approximate Range Table for Star Shell. Charge, 3½ lbs.

Range.	Elevation.	Length of Fuze.
1,000 yards.	7° 0′	2·5
1,100 ,,	7° 53′	5·0
1,200 ,,	8° 49′	7·5
1,300 ,,	9° 49′	10·0
1,400 ,,	10° 54′	12·5
1,500 ,,	12° 3′	15·0
1,600 ,,	13° 18′	17·5
1,700 ,,	14° 38′	20·0
1,800 ,,	15° 3′	22·5
1,900 ,,	17° 33′	25·0
2,000 ,,	19° 6′	27·5
2,100 ,,	20° 42′	30·0

TABLE showing Gradients corresponding to Angles of Descent.

Angle of Descent.		Slope of Descent.	Angle of Descent.		Slope of Descent.
degs.	mins.		degs.	mins.	
1	9	1 in 50	27	10	1 in 1·95
1	55	1 „ 30	27	47	1 „ 1·90
2	13	1 „ 26	28	24	1 „ 1·85
2	18	1 „ 25	29	3	1 „ 1·80
2	23	1 „ 24	29	45	1 „ 1·75
2	52	1 „ 20	30	28	1 „ 1·70
3	1	1 „ 19	31	13	1 „ 1·65
3	11	1 „ 18	32	2	1 „ 1·60
3	23	1 „ 17	32	50	1 „ 1·55
3	35	1 „ 16	33	42	1 „ 1·50
3	49	1 „ 15	34	36	1 „ 1·45
4	5	1 „ 14	35	32	1 „ 1·40
4	24	1 „ 13	36	32	1 „ 1·35
4	46	1 „ 12	37	34	1 „ 1·30
5	13	1 „ 11	38	41	1 „ 1·25
5	43	1 „ 10	39	50	1 „ 1·20
6	19	1 „ 9	41	2	1 „ 1·15
7	11	1 „ 8	42	16	1 „ 1·10
8	8	1 „ 7	43	38	1 „ 1·05
9	28	1 „ 6	45	0	1 „ 1·0
10	18	1 „ 5·5	46	28	1 „ ·95
11	19	1 „ 5·0	48	1	1 „ ·90
11	46	1 „ 4·8	48	39	1 „ ·88
12	16	1 „ 4·6	49	18	1 „ ·86
12	48	1 „ 4·4	49	58	1 „ ·84
13	23	1 „ 4·2	50	39	1 „ ·82
14	2	1 „ 4·0	51	20	1 „ ·80
14	45	1 „ 3·8	52	3	1 „ ·78
15	32	1 „ 3·6	52	46	1 „ ·76
16	23	1 „ 3·4	53	30	1 „ ·74
17	22	1 „ 3·2	54	15	1 „ ·72
18	26	1 „ 3·0	55	0	1 „ ·70
19	2	1 „ 2·9	55	46	1 „ ·68
19	40	1 „ 2·8	56	34	1 „ ·66
20	20	1 „ 2·7	57	23	1 „ ·64
21	3	1 „ 2·6	58	13	1 „ ·62
21	48	1 „ 2·5	59	3	1 „ ·60
22	38	1 „ 2·4	59	53	1 „ ·58
23	31	1 „ 2·3	60	45	1 „ ·56
24	26	1 „ 2·2	61	38	1 „ ·64
25	28	1 „ 2·1	62	35	1 „ ·52
26	34	1 „ 2·0	63	26	1 „ ·50

Drill.

Travelling Carriage fitted with Hydraulic Buffer.

(*See* Manual of Artillery Exercises, Part III, Section VI).

The detachment consists of 10 Nos., and falls in two deep. It is told off, marched into the battery, and halted in line, facing the parapet and to the left rear of the platform. It is now in the position of "detachment rear."

To Take Post under Cover.*

Officer.	*No.* 1.
Take post under cover.	*Right turn.* *Double march.*

The detachment wheels to its left, the front rank filing to the left of the gun, the rear rank to the right; 2 and 3 halt close to the parapet on the right and left of the platform; 4 and 5 form up on their right and left, and the whole turn to the right about together. No. 1 follows in rear of the detachment, keeping under cover as much as possible; 6 and 8 going to the cartridge store; 7, 9, and 10 to the shell store.

General Duties.

No. 1 commands, directs, or superintends boring and fixing fuzes, assists to run up, and lays.

No. 2 searches, sponges, lifts projectile, rams home, runs up, and traverses.

No. 3 loads, lifts projectile, uncaps or removes safety pin from fuze when in bore, rams home, runs up, and traverses.

No. 4 attends to side arms and supplies them to 2, runs up, and elevates.

No. 5 attends to vent, supplies 3 with automatic gas-checks, runs up, makes ready, and fires.

No. 6 supplies 3 with cartridges.

No. 7 attends to fuzes and brings up projectiles in bearer, and assists to lift them to the muzzle.

No. 8 attends to cartridge store, and serves out cartridges to 6.

No. 9 assists 7.

No. 10 attends to shell store, issues shells, tubes, and fuzes.

To Prepare for Action.

Officer.	*No.* 1.
Prepare for Action.	*Prepare for Action.* *Examine gun.*

"*Prepare for action.*"—The stores are brought up as follows:

No. 1, handspike and sights.

No. 2, handspike, and assists 4 with side arms.

No. 3, handspike, removes the tampeon from muzzle.

No. 4, handspike, side arms, and support for head of side arms.

No. 5, handspike, tubes in pocket, lanyard, pricker, and vent server.

No. 6, two cartridge cases, which he leaves at the cartridge store, bucket filled, and brush. For drill purposes two drill cartridges.

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* If the gun is not behind a parapet, and the word of command is "*Take post at the gun,*" the detachment wheels to its left as before, 2 and 3 halt in line with the front of the wheels; 4 and 5 with the rear of the wheels, No. 1 in rear of the gun, 6, 7, 8, 9, and 10 at the limber.

No. 7, fuzes and uze and shell implements. He obtains the fuze boxes from 10, having ascertained from No. 1 the fuzes required; and satisfies himself as to the correctness of fuzes and fuze implements. He places the fuze boxes on the shell benches in the covered way on left of gun portion where the shells are fuzed.

No. 8 prepares to issue cartridges.

No. 9 provides a brush and shell bearer, also automatic gas-checks in box with lid unscrewed. No. 10 prepares to issue shells, friction tubes, and fuzes. He examines the shells carefully, cleaning them if necessary; he loosens the fuze-hole plugs of shells that will be first issued.

The stores having been brought up, No. 1 will satisfy himself that the foresights fit properly on the gun and the horizontal bars of the sights work easily; he receives the reports from the Nos. responsible of any irregularity or deficiency in connection with the gun, ammunition, or stores.

The sponge, rammer, and wadhook are laid on the ground clear of the platform, to the right of the gun and parallel to it, heads to the rear, resting on the support supplied by 4, sponge nearest the gun. The sponge bucket near the sponge head.

The handspikes are laid down, two on each side of the gun close to the carriage, points to the front, bevelled side uppermost, those of 2 and 3 outside, and about two feet advance of those of 4 and 5. No. 1's handspike in rear of the platform.

No. 3 examines the bore to see the grooves are free from grit, &c.

No. 4 ascertains that the elevating gear is in working order (should the elevating arc have been detached from the carriage he brings it up and adjusts it).

No. 5 straps the tube pocket round his waist on the right side, coils up the lanyard, and passes the bight of it through the tube pocket strap; examines the vent server, and places it in the vent, the loop of the vent server lanyard over one of the sights; he fills his tube pocket with friction tubes, which he procures from 10, and places the pricker in the loop on the carriage, and sees that the automatic gas-checks are placed in a convenient position.

N.B.—Should the stores be on the gun, they are unstrapped and laid down as above detailed.

"*Examine gun.*"—No. 5 drifts the vent, replaces the pricker in the loop and the vent server. 2 supplies himself with the wadhook, searches the gun after the pricker has been withdrawn, and replaces wadhook. 4 attends to the elevating wheel to bring the gun into a convenient position for loading.

To Load.

Officer.	*No.* 1.
Range—Yards. *With—Load.*	*With—Load.*

"*Load.*"—No. 1 gives 7 the nature of shell and fuze required, and during the loading fixes his tangent scale at the required elevation. He places himself in a convenient position, near the muzzle, whence he can watch the loading, and observe by the mark on the rammer if the shell is home.

No. 2 places himself in a convenient position for sponging. He places his left foot in line with and about 12 inches from the muzzle, steps to his right with his right foot, and looks to his left rear, takes the sponge in a horizontal position from 4, left hand back down, right hand back up, brings it in line with the axis of the gun, enters the head into the bore, being careful to observe that the vent server is in the vent, slides his hands along the stave to his right as far as he can reach, sends the sponge up the bore, slides his hands out again and forces the sponge hard home, gives it two half turns, pressing it against the bottom of the bore, withdraws the sponge hand over hand, turning it from him, cleaning the bore well. When the sponge arrives near the muzzle, he jerks it out, his hands should then be in the position they were in when he introduced the sponge into the bore. He then hands the sponge to 4 and assists 3, 7, and 9 to lift the projectile and place it in the bore, receives the rammer, right hand about the centre back down, left as near the head as

possible back up; as soon as the cartridge and shell are put in, he enters the head into the bore, and forces them home hand over hand. He then springs the rammer, steps out, hands it to 4, and goes under cover.

No. 3 as soon as the sponge is withdrawn takes the cartridge from the cartridge case with his left hand, moves up and places it in the bore, receives a gas-check from 5 and places it in the bore immediately in front of the cartridge, painted side to the rear; he then assists 2, 7, and 9 to lift the projectile and place it in the bore, withdraws the safety pin, or uncaps the fuze, places himself in a corresponding position to 2 and assists him to ram home; when the cartridge and projectile are home he quits the stave and goes under cover.

No. 4 doubles out, halts in line with the sponge head, turns to his left, picks up the stave with his right hand back under, 6 inches from the head, turns three-quarters left about, and in doing so lifts the sponge over his head, allowing the end of the stave to rest on the ground. His left hand meets the stave close to the sponge, his right hand is slipped up the stave about two feet. He then moves towards the muzzle and places the sponge in a convenient position for 2 to lay hold of, waiting for its return at the left rear of 2, facing the gun. When he receives the sponge from 2, he allows the end of the stave to fall on the platform, steps to his left, turns three-quarters right about, passing the sponge over his head, lays it down, takes up the rammer as before detailed for the sponge, and hands it to 2. He then remains in position to receive the rammer as soon as 2 has sprung it. He lays it down as he did the sponge and goes under cover.

No. 5 hands a gas-check to 3.

No. 6 brings up a cartridge in a case and places it on the ground on 3's right front; after the sponge is withdrawn he uncovers it, and as soon as 3 has withdrawn the cartridge, 6 takes the case back to the cartridge store.

Nos. 7 and 9 bring up a shell in bearer, having fixed the fuze according to No. 1's direction, and assisted by Nos. 2 and 3 place it in the bore. No. 9 removes the empty shell bearer.

No. 8 issues a cartridge to 6.

No. 10 issues a shell to 7 and 9.

3 JUN 39

To run up.

Directly the gun is loaded, No. 1 gives "*Run up*."

Nos. 2, 3, 4, 5 take up their handspikes; 2 and 3 apply theirs horizontally over the spokes of the wheels in front, and under the bracket, close to the breast, and bear down; 4 and 5 use theirs as levers of the second order under the rear part of the wheels. All four numbers face to the rear.*

When the gun is run up, No. 1 gives "*Halt*," slides his handspike to the rear clear of the recoil, and looks over the sights, steadying himself by leaning on the cascable. 2 and 3 go to the end of the trail facing to the rear ready to traverse, 4 and 5 lay down their handspikes, 4 goes to the elevating wheel; 5 prepares a tube.

To Lay the Howitzer.

Officer.	*No. 1.*
	Elevate.
	Depress.
	Halt.
	Trail right.
	Trail left.
	Halt.

At "*Elevate*" or "*Depress*," 4 turns the wheel in the required direction till the word "*Halt.*"

At "*Trail right*," 3 heaves over the trail, at "*Trail left*" 2, till the word "*Halt.*"

* Running back at Drill is the converse of the preceding.

At "*Extreme right or left,*" 2 and 3 apply their handspikes, and with 4 and 5 heave over the trail; when it is necessary to shift the trail plank, 2 and 3 place the points of their handspikes under the trail and raise it; 4 double mans 2's handspike, 1 and 5 shift the plank.

If it is necessary to run the gun back, at "*Run back*" 2 and 3 apply their handspikes in front of the wheels, using them as levers of the second order: 4 and 5 take a purchase with theirs over the most horizontal spokes in rear and under the brackets; the whole facing to the rear.

Should no order to fire be given when the gun is laid, No. 1 gives the order "*Under cover.*"

To Make Ready and Fire.

Officer.	*No.* 1.
Fire———*rounds.*	*No.*———*Ready.* *No.*———*Fire.*

No. 1 lowers his tangent scale and gives "*Ready;*" 5 presses the tube into the vent with his right thumb, steps clear of the recoil, shifts the lanyard to his right hand and extends it, keeping his hand level with the vent, facing the gun.

As soon as "*Ready*" is given, 2 and 3 lay down their handspikes and with 4 go under cover.

At "*Fire*" 5 draws the lanyard strongly towards his body, without a jerk; he then drifts the vent, replaces the vent server and goes under cover.

No. 1 does not again give "*Load*" until 5 has replaced the vent server.

When the charge is below 6 lbs., up to 30° elevation may be given; when the charge is 6 lbs. or over, not more than 20°.

Instructions for the Disablement or Destruction of Guns by means of Gun-cotton.

(*See Clause* 137 *of Army Circulars,* 1886.)

The Destruction of Heavy Guns when Time is immaterial.
The Hasty Disablement of Siege Guns.

The Destruction of Heavy Guns when Time is immaterial.

This duty will be performed by the Royal Artillery, the stores marked (*a*) in the following list being obtained from the Royal Engineers; and the remainder taken from the siege train equipment.

The materials required are as follows:—

(*a*). Guncotton (1 lb. slabs), perforated, to receive a dry primer; 2 slabs for each charge, and spare slabs at the rate of 2 spare for every 5 (or less number) of guns to be destroyed.

The "guncotton wet slabs, 2 perforations," mentioned in List of Changes, § 4883, *are cut in half to form these* 1-*lb. slabs. They are issued wet, and arrangements are made for so keeping them, but it is immaterial whether they are wet or dry when required for use.*

(*a.*) Guncotton primers, dry, weighing 1 oz., 1¼ inch in diameter, coated with paraffin; 1 primer for every two slabs.

Bags, waterproof, to contain 2 lb. of guncotton, 1 for every 2 slabs carried.

(*a.*) Exploder, dynamo-electric, quantity.

(*a.*) Solution, indiarubber, in tin cylinder.

(*a.*) Twine, stout, 1 lb.
This is sufficient for about 20 *charges.*

(*a.*) Detonators, No. 13, in a cylinder containing 25 detonators, with a rectifier.
Each cylinder will suffice for 20 *charges, with* 5 *spare detonators.*

(*a.*) Wire, insulated, lengths of 40 yards each.
Five additional yards are required for each charge after the first operation, to replace the wire blown away by a discharge.

Tackle and selvagees, with rollers, skidding, handspikes, &c., for lowering the gun into a pit, or up-ending it under the branch of a tree.
The exact proportion of these cannot be given. It will depend upon the size of the guns to be destroyed, upon local circumstances, &c.

Directions for carrying out the Operations.*

Plug up, with a peg of wood, the vent of the gun to be disabled, driven well in so as to make the vent watertight.

Up-end the gun on its breech, either by digging a pit for its reception, or by other convenient means.

The Officer in charge of the operations must be guided by local circumstances, but the more the gun is raised vertically on its breech the better.

Clean the terminals of the insulated wire, and of the wires attached to the detonators, by scraping. The detonator is then to be connected with the insulated wires. To secure perfect electrical circuit the junctions must be insulated from each other by smearing them over with indiarubber solution, and wrapping them with tape (indiarubber or calico).

Insert the detonator, after securing it to the wires, into a dry primer, first using the rectifier to ensure the hole in the primer being of a proper size to admit the detonator, which should be set home to the head.

On no account whatever should a detonator be twisted or roughly forced into a primer.

Insert the dry primer, fitted with detonator, into the perforation in one of the 1 lb. slabs, pushing it gently in until the hole in the slab is quite filled by it.

Place the slab thus prepared, together with another slab, in a waterproof bag.

Choke the neck of the bag with twine closely round the insulated wires; plaster the inner portion of the choke round the wires with the indiarubber solution, and choke again round and above the solution so as to make the whole as watertight as possible.

Attach to the wires a small sinker of any heavy material, so that its weight comes on them above the choke. The sinker should be small in bulk, so as to allow the charge to settle home to the bottom of the bore; and, when hanging freely from its point of support, it should be just below the bottom of the bag.

Attach to the choke a piece of stout twine long enough to reach to the bottom of the bore of the gun, and lower the charge by it carefully to the bottom of the bore, paying out the insulated wires at the same time, and taking care that no strain comes on them.

In operating upon guns of the heavier natures, it is advisable, in order to ensure their destruction, to employ two charges, to be fired simultaneously in different parts of the gun's bore. These charges should be prepared as directed, and should then be firmly attached to a stick of such length that, when inserted into the gun, one of the charges shall be at the breech of the gun while the other should be just above the trunnions. One of the wires from the exploder should be attached to the detonator in the lower charge, the other wire from the exploder being attached to one of the wires of the detonator in the upper charge. The other wires of the detonators should be connected together by a piece of insulated wire. The whole of the connections must be carefully insulated.

---

* *See* note at end.

(The sinker, which should be attached to the stick, or the lower charge, must be sufficiently heavy to prevent the charges floating.)

Fill up the bore with water; connect the free ends of the insulated wires with the binding screws of the exploder, and, after seeing that all is clear, fire the charge by turning, or pressing down, sharply the handle of the exploder.

This should be done immediately after lowering the charges into the gun, so as to give the water as little time as possible to effect an entrance into the bag.

The operator should be careful to place himself and his party under cover, and the terminals of the conducting wires are not to be connected to the exploder until all present have placed themselves under cover.

In the event of a detonator failing, at once disconnect the wires from the exploder. The charge must then be taken up and re-made, with a fresh detonator. Great caution must be exercised in slowly extracting the detonator from the primer.

Cautions.

Care should be taken to see that the insulation of the wire is perfect, that the connections are clean and good, and that they are afterwards thoroughly insulated, according to the directions given.

If any part of the wire is accidentally denuded of its insulation, prop up the adjacent insulated portion, so that the bared portion will not touch the ground. If time allows, it is better to wrap the defective place thoroughly in indiarubber tape.

Detonators by themselves must always be handled with the greatest care and freedom from rough usage, and still more so when they are fitted into guncotton. The latter by itself is harmless.

Immediately after an explosion, detach the wires from the exploder, and do not re-attach them till just before firing the next charge, as directed.

The Hasty Disablement of Siege Guns.

The hasty disablement of siege guns will be carried out by the Royal Artillery.

Stores required.

The necessary supplies of guncotton for the disablement of siege guns will be obtained from the Royal Engineer Siege Park.

The following stores will be carried with each unit of the Siege Train :—

Boxes	guncotton, slabs* 1—½ slab	8
	guncotton, slabs* 8—½ slabs	1
	stores, disabling, ordnance, siege	1
	vesuvian matches	1
Cases	detonator, for 8†	2
	guncotton primers†	2
	guncotton slabs†	4
Cylinders	detonator, No. 8, for 8	2
	guncotton primer, dry, 1¼ in. × 1¼ in., for 8	2
Detonators, No. 8		16
Guncotton	dry primers, 1 perforation, 1¼ in. × 1¼ in.	16
	wet slabs, 2 perforations, 6⅛ in. × 6⅛ in. × 1⅜ in.	8‡
Pouches, match-box†		1
Rectifiers, guncotton primers		2
Twine, choking, 3-thread	pieces	1

* Copper, tinned. † Leather.

‡ In half slabs, 1 perforation in each.

INSTRUCTIONS FOR CARRYING OUT THE OPERATIONS.*

In the case of guns of 64-pr. and larger calibres two slabs must be employed.

Insert a detonator into a dry primer.

On no account should a detonator be twisted or roughly forced into a primer.

Insert the dry primer fitted with detonator into the perforation in one of the slabs, pushing it gently in until the hole in the slab is quite filled by it.

Tie a piece of twine round the detonator, pass the ends round the slab, and then tie them together; the object being to prevent the primer slipping out of the slab.

Place the slabs lengthways on the chase, their long sides touching, about a foot from the muzzle. Tie them on tightly with twine to prevent them slipping, from wind or other disturbing cause.

The exact position must depend on the form of the gun. The great thing is to have as much of the surface of the cotton *in actual contact* with the gun as possible. Hence the slabs should not ride on an astragal or moulding, but should always be placed on a plain part of the chase.

Observe the direction of the wind, and arrange the slab containing the detonator so that the tail of the safety-fuze is away from the slab and to leeward of it. This is to lessen the chance of a spark igniting the guncotton before the detonator is fired, in which case, in all probability, no effect whatever would be produced on the gun.

If projectiles belonging to the gun are available, and time allows, it is advisable to ram one up the bore; so that when the gun is dented by the explosion it may be imprisoned there and prevent the gun from being used even to fire a bag of bullets.

Tear or cut the little calico cap off the end of the safety fuze and ignite the fuze by the vesuvian matches provided, or other convenient means. An ordinary flame does not readily ignite it. The fuze ignites most easily when cut obliquely with a sharp knife.

Retire under cover, and await the explosion. The length of safety-fuze will burn about 45 seconds.

Should circumstances permit, the effect of the detonation will be increased by placing a filled sand bag or a sod of turf on the guncotton, when lashed in position on the chase. Great care should be taken in this operation not to strike or bend the detonator.

It is also advisable, after the explosion, to try if the gun is so dented as to prevent loading. If the dent is not sufficient, the operation should be repeated, putting the fresh slabs in the same place as the first.

3 JUN 39

Caution.

Never roughly bend or kink the safety fuze. If it has apparently gone out without firing the detonator, allow at least half-an-hour to elapse before meddling with it, if time will admit, but if not, the greatest care must be taken in touching it, to avoid accident by a "hang-fire."

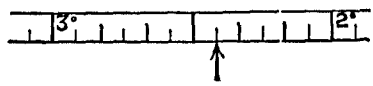
---

* NOTE.—The above instructions have been prepared with special reference to the disablement or destruction of muzzle-loading guns. Breech-loading guns can generally be temporarily disabled by the removal or destruction of portions of the breech apparatus. In destroying such guns, or rendering them permanently disabled, Officers will, while being guided generally by these instructions, use their discretion as to the application of the charges in such positions as may appear most suitable, according to the particular construction of the gun to be operated upon.

INSTRUCTIONS FOR USE OF WATKIN'S CLINOMETER.

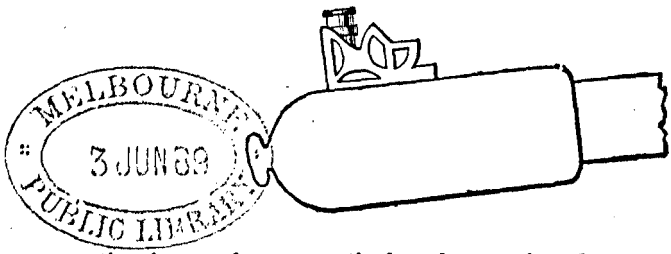
To read the angles marked on the drum.—The brass drum is marked in degrees, commencing at 0° on the top to 45° at the bottom. Each degree is subdivided into twelve parts; each small division therefore represents angles of 5 minutes.

The scale is read from right to left, thus—



the reading opposite the arrow would indicate an angle of 2° 25′.

To lay a gun or howitzer at any angle up to 45°.—Unscrew the drum until the ↑ points to the elevation required, place the clinometer, thus—



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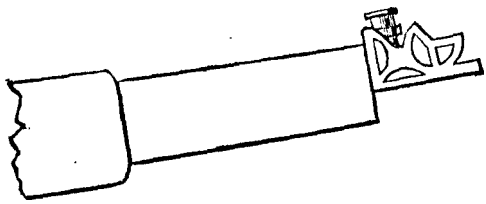
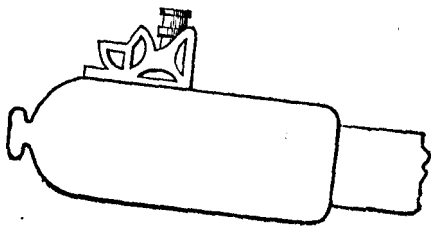
on the plane surface cut on the breech, or against the muzzle, thus—

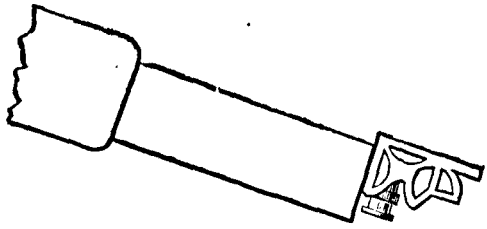


and elevate the piece until the bubble of the spirit-level is in the centre of the tube.

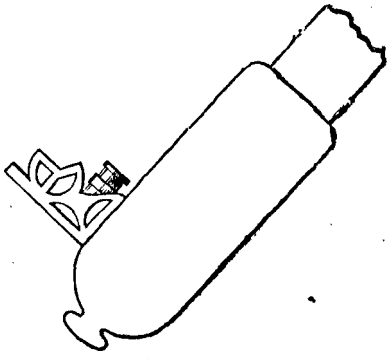
For angles of depression.—Proceed as above, but reverse the direction of the instrument, placing it thus on the breech of the gun—



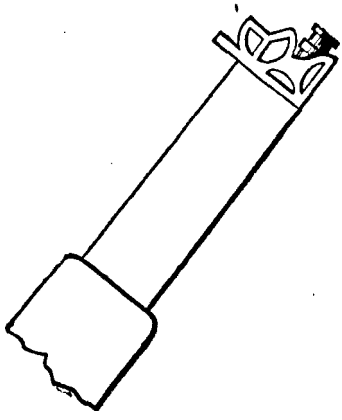
and thus on the muzzle—



For angles of elevation greater than 45°.—Subtract the angle of elevation required from 90°, unscrew the drum to this reading ; thus, for 60°, unscrew the drum to 30°, and place the instrument on the breech of the gun, thus—



or on the muzzle, thus—



and elevate until the bubble is in the centre of its run.

Copies of the above instructions will be issued with the instruments.

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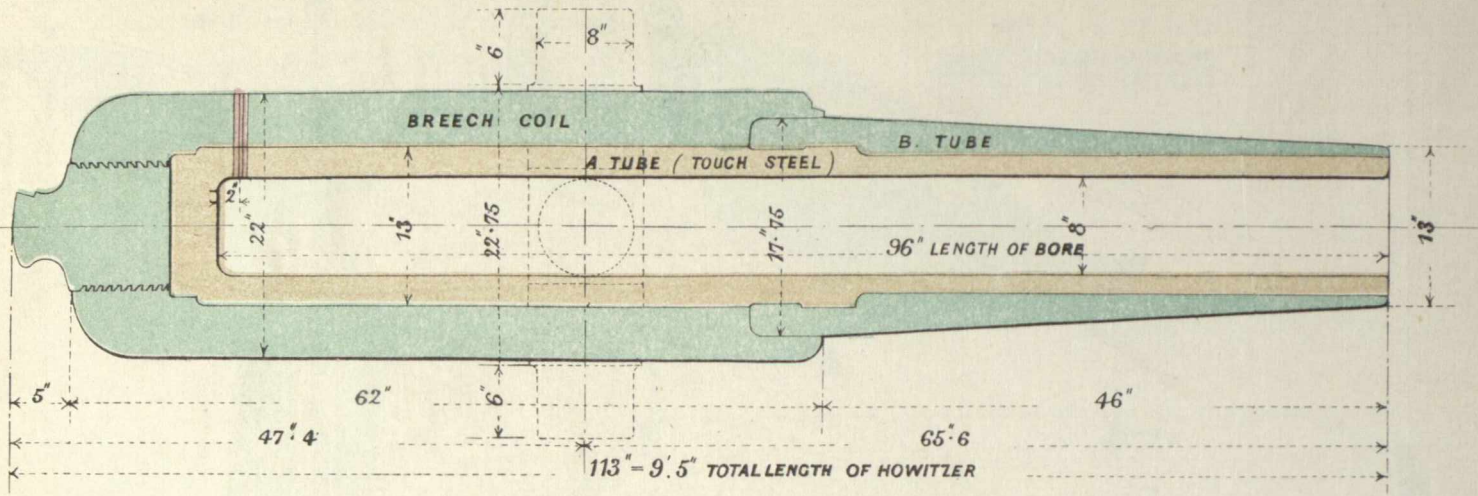
Plate I.

ORDNANCE, WROUGHT, IRON, R.M.L. HOWITZER, 8 INCH 70 CWT. MARK I.

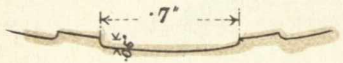
Scale $\frac{1}{16}$.

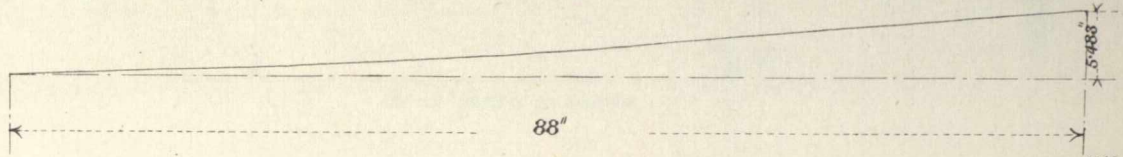


NUMBER OF GROOVES 24.

RIFLING, AN INCREASING TWIST FROM 1 TURN IN 90 CALS. AT BREECH TO 1 TURN IN 35 CALS. AT MUZZLE

GROOVE FULL SIZE.





4143

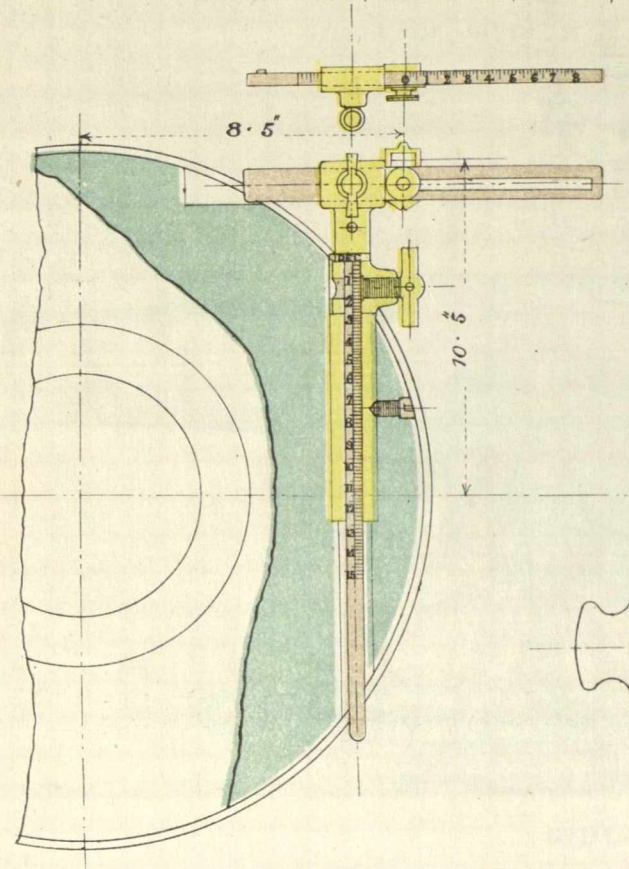
DANGERFIELD, LITH. 22, BEDFORD ST. COVENT GARDEN.

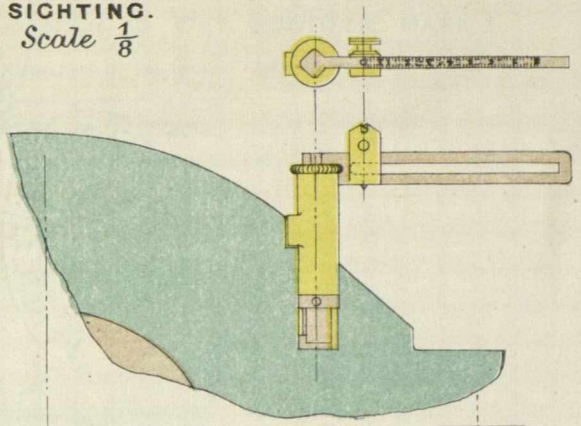
Plate II.

ORDNANCE, WROUGHT, IRON, R. M. L. HOWITZER, 8 INCH 70 CWT MARK I.

SIGHTING.

Scale $\frac{1}{8}$





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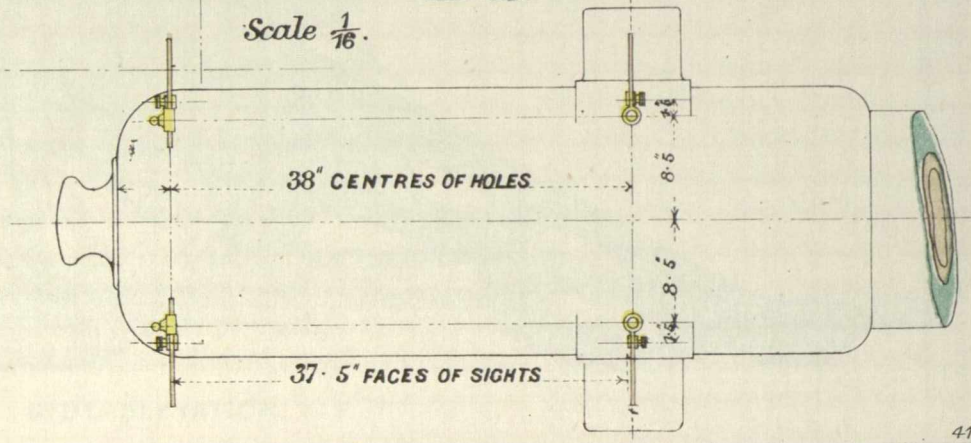


4143

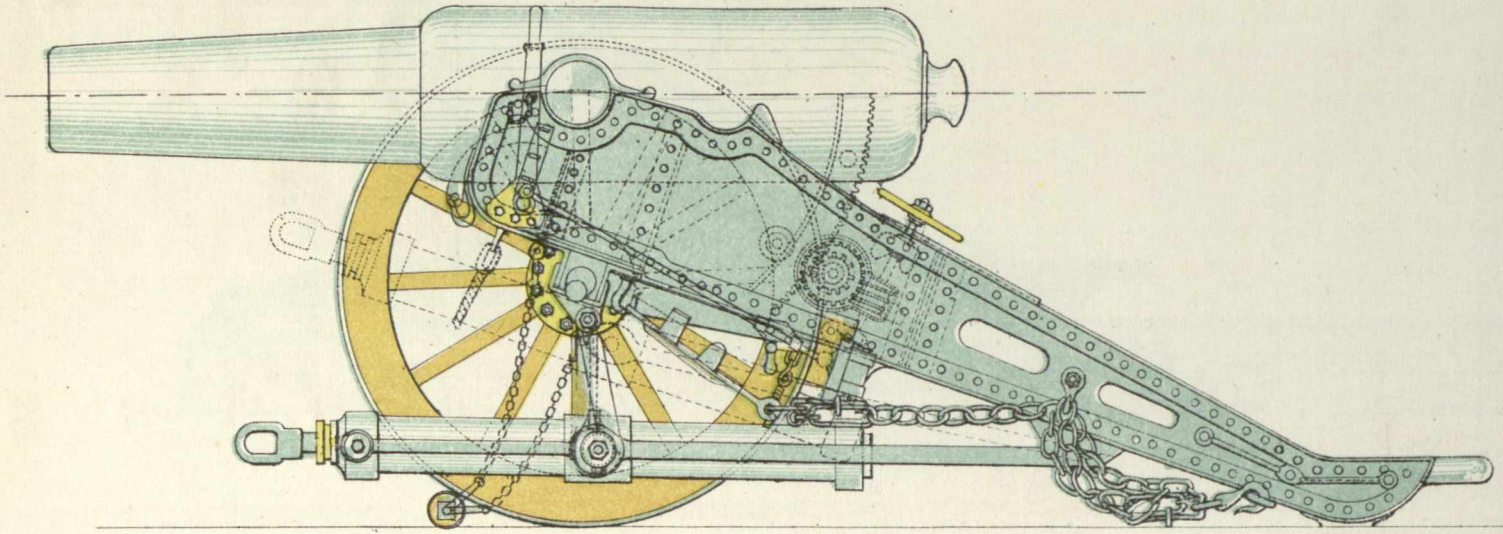
DANGERFIELD, L.TH. 22, BEDFORD ST. COVENT GARDEN.

Plate IV.

CARRIAGE, SIEGE, R.M.L. 8 INCH 70 CWT. HOWITZER. MARK I.

(For anchoring apparatus or front pivot.)

Scale, $\frac{1}{24}$ full size.



SIDE ELEVATION.

4143

DANGERFIELD, LITH. 22, BEDFORD ST. COVENT GARDEN.

Plate V.

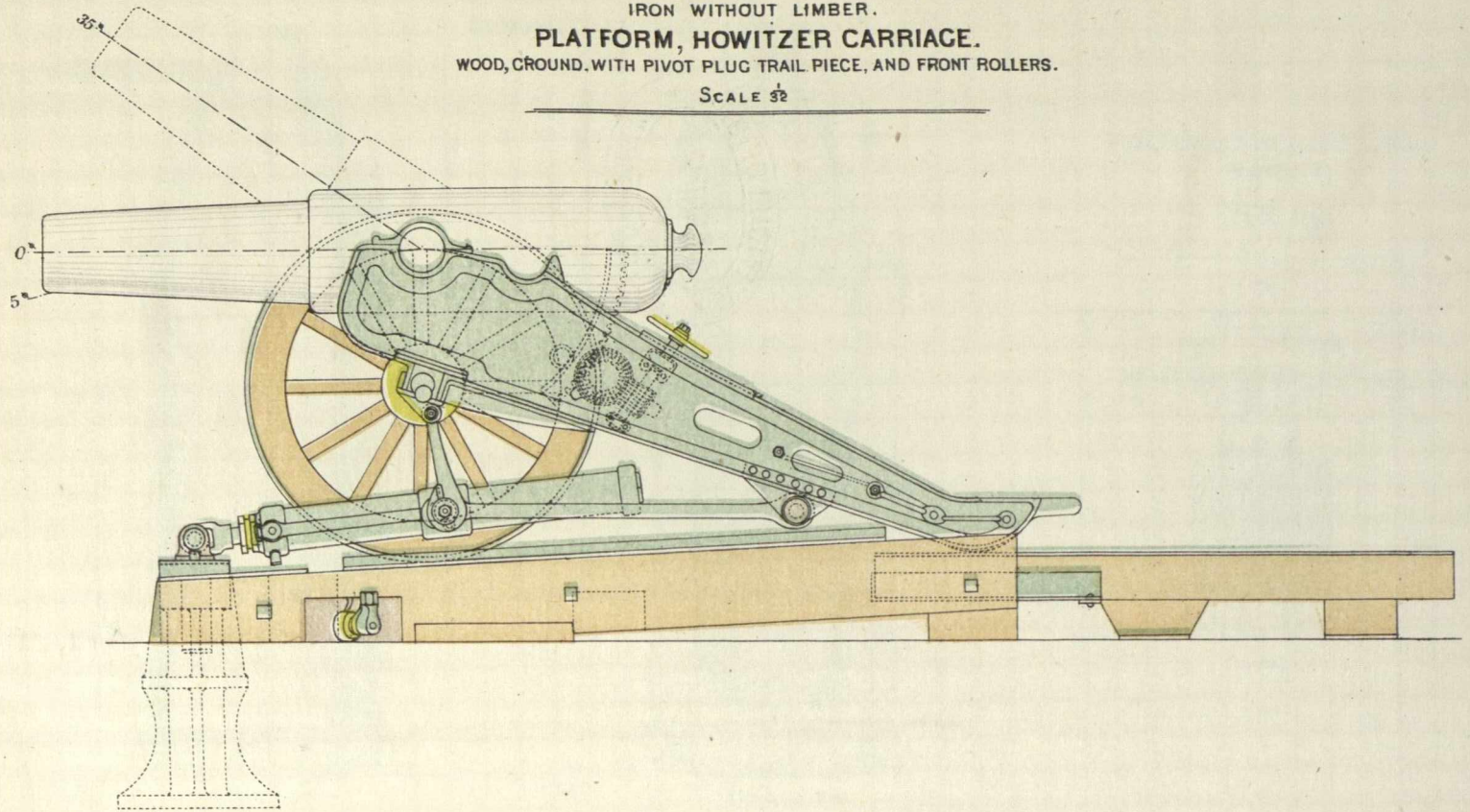
CARRIAGE, SIEGE, R.M.L. 8-INCH, 70-CWT. HOWITZER, FOR "A" PIVOT.

IRON WITHOUT LIMBER.

PLATFORM, HOWITZER CARRIAGE.

WOOD, GROUND. WITH PIVOT PLUG TRAIL PIECE, AND FRONT ROLLERS.

SCALE $\frac{1}{32}$

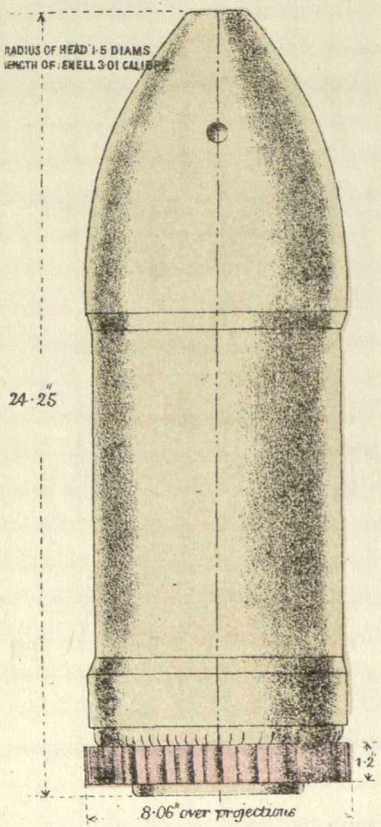


DANGERFIELD, LITH. 22, BEDFORD ST. COVENT GARDEN 11972 (5.86)

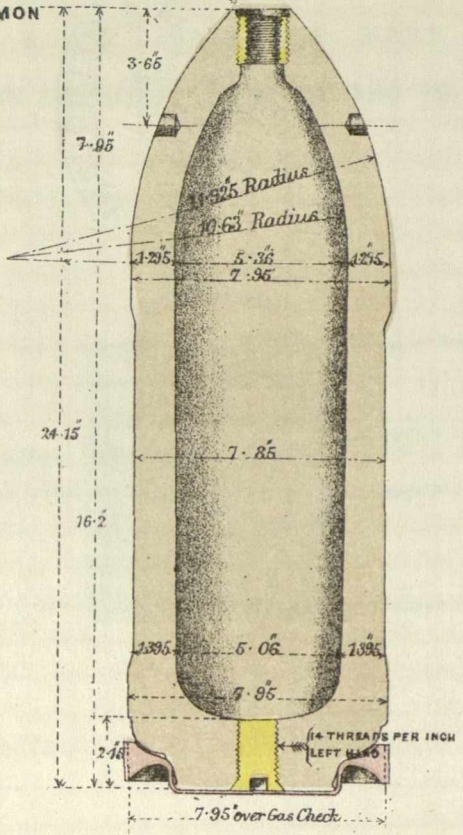
Plate VI.

PROJECTILES 8 INCH R.M.L. HOWITZER OF 70 CWT.

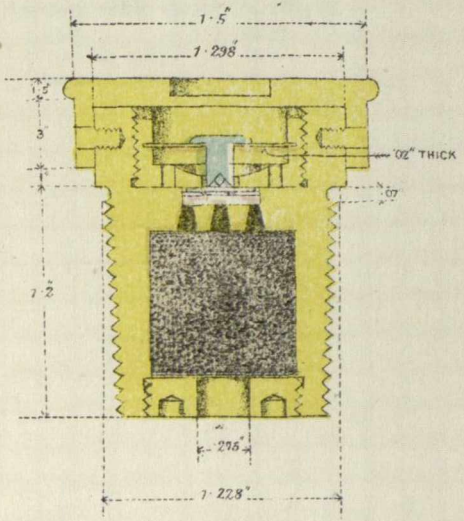
SCALE $\frac{1}{6}$



COMMON



FUZE, PERCUSSION, DIRECT ACTION.
MARK I.
Full Size.



4143

DANGERFIELD, LITH. 22, BEDFORD ST. COVENT GARDEN.

Plate. VIII.

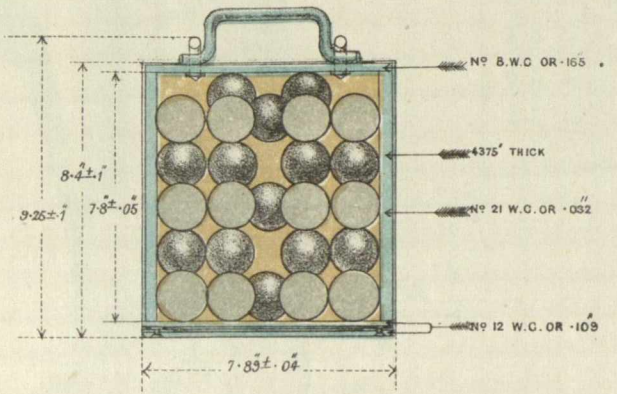
SHOT, R. M. L. CASE, 8 INCH. MARK III.

FOR GUN AND HOWITZER 70 CWT AND 46 CWT.

SCALE $\frac{1}{8}$

LENGTH OF SHOT = 1·05 CALIBRES.

AVERAGE TOTAL WEIGHT	74. 0 ± 2½ LB.
CASE	28. 1½
CLAY AND SAND	9. 8
75 SAND SHOT (8 OZ)	36. 7½



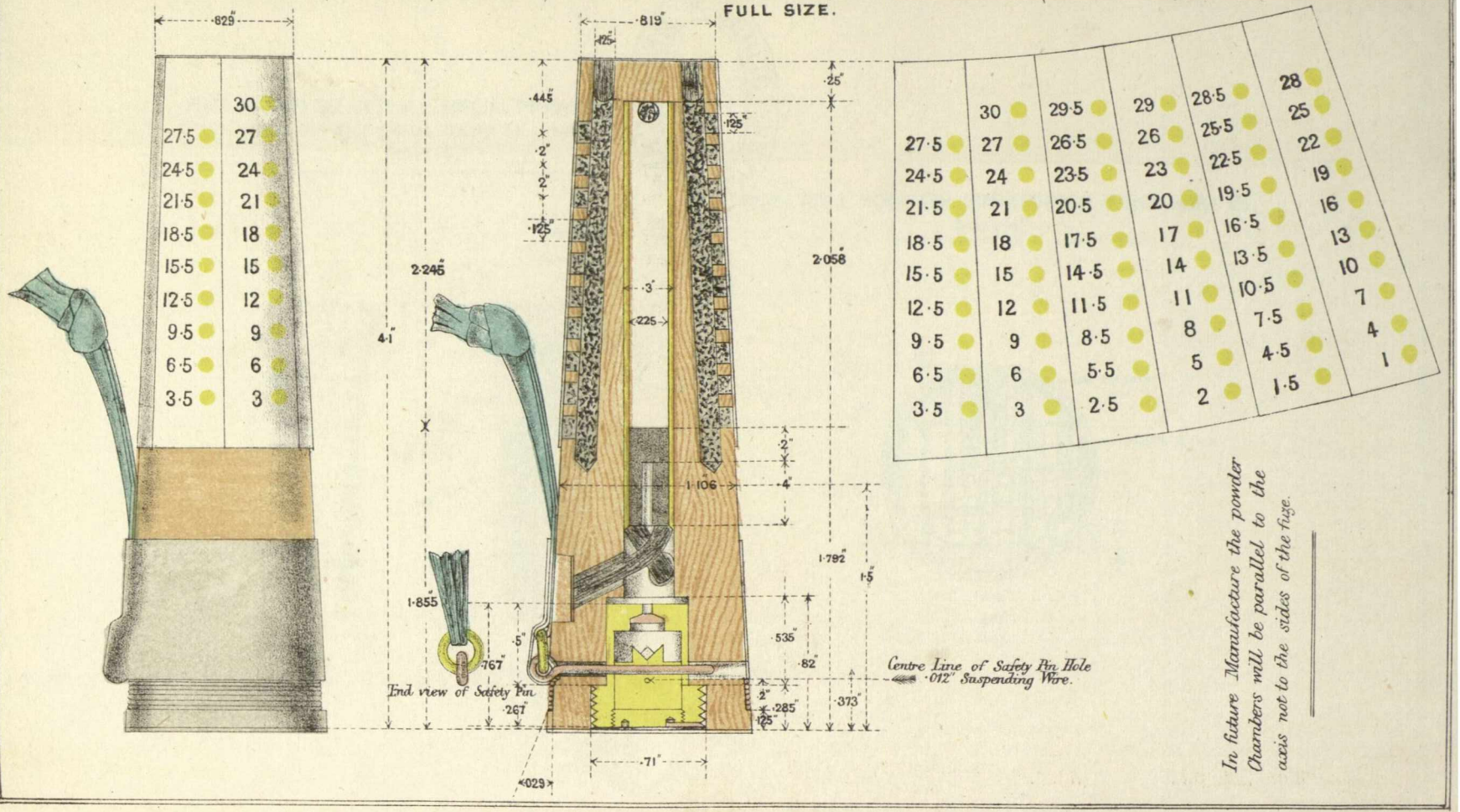
DANGERFIELD, LITH. 22 BEDFORD ST. COVENT GARDEN. 1876.

Plate VIII.

No 4123 $\frac{F}{458}$ (A)

FUZE, TIME, WOOD, WITH DETONATOR, 15 SECONDS. (MARK III)

FULL SIZE.



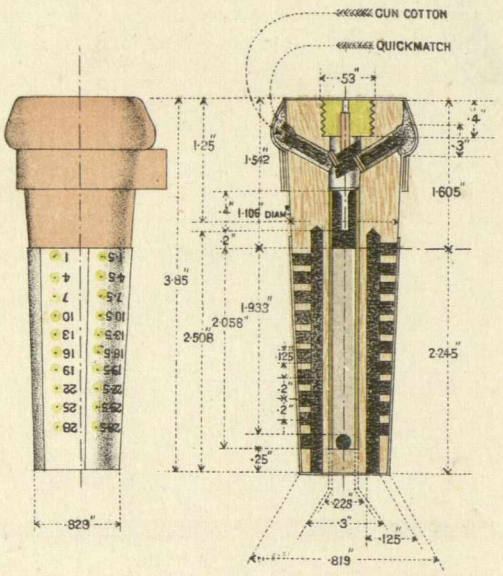
In future Manufacture the powder Chambers will be parallel to the axis not to the sides of the fuze.

Plate IX.

FUZE TIME 15 SECONDS M.L. SPECIAL PRIMING - MARK I.

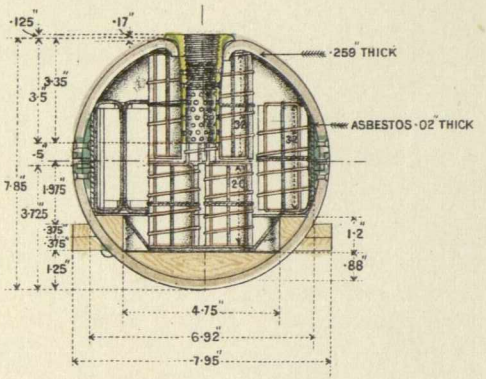
WOOD FOR STAR SHELLS EXCEPT 2·5 ARMSTRONG.

SCALE ½.



SHELL R.M.L. HOWITZER STAR SPHERICAL 8 INCH - MARK III.

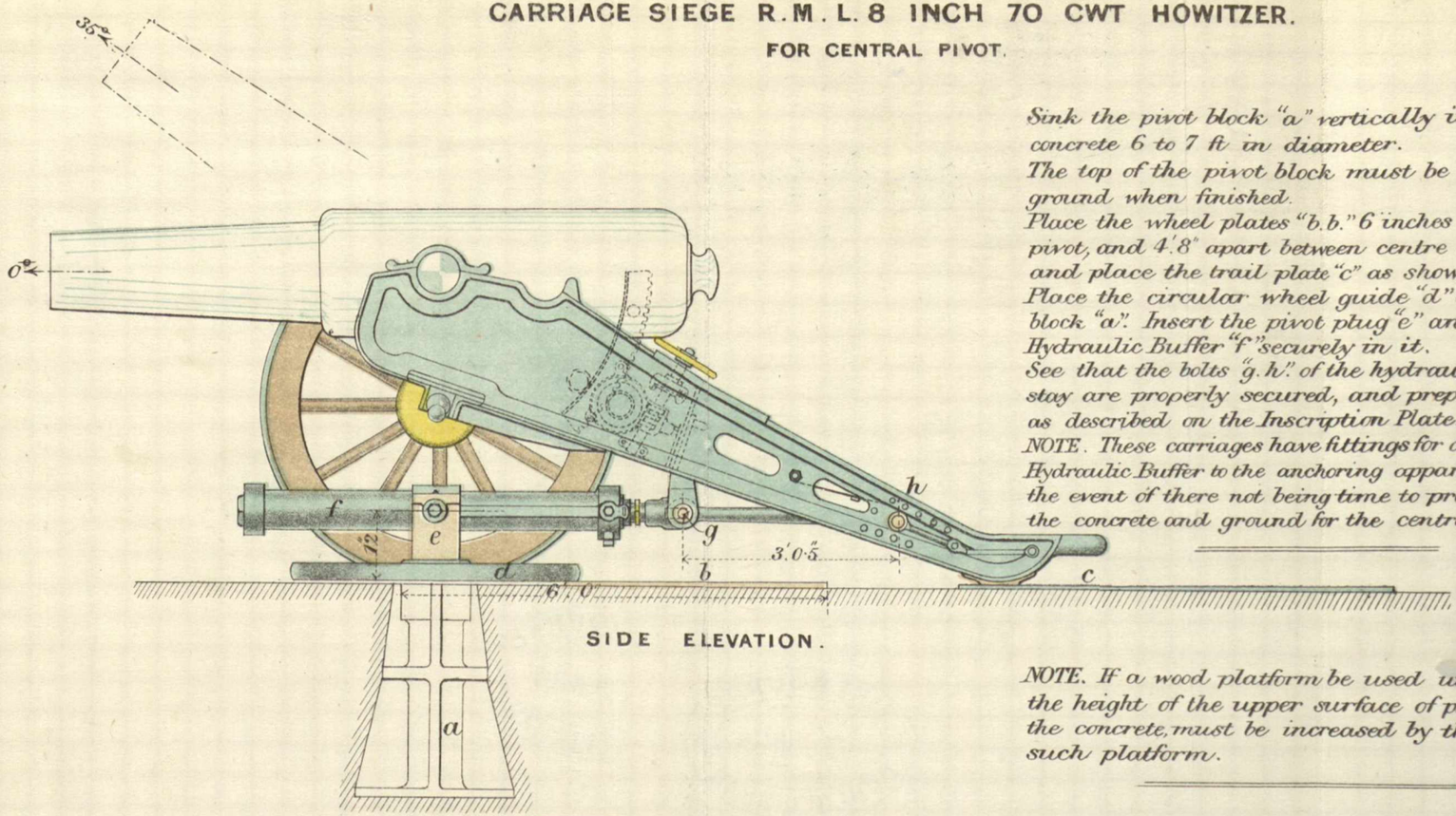
SCALE $\frac{1}{6}^{TH}$



DANGERFIELD, LITH. 22, BEDFORD ST. COVENT GARDEN 11972(5·86)

CARRIAGE SIEGE R.M.L. 8 INCH 70 CWT HOWITZER.

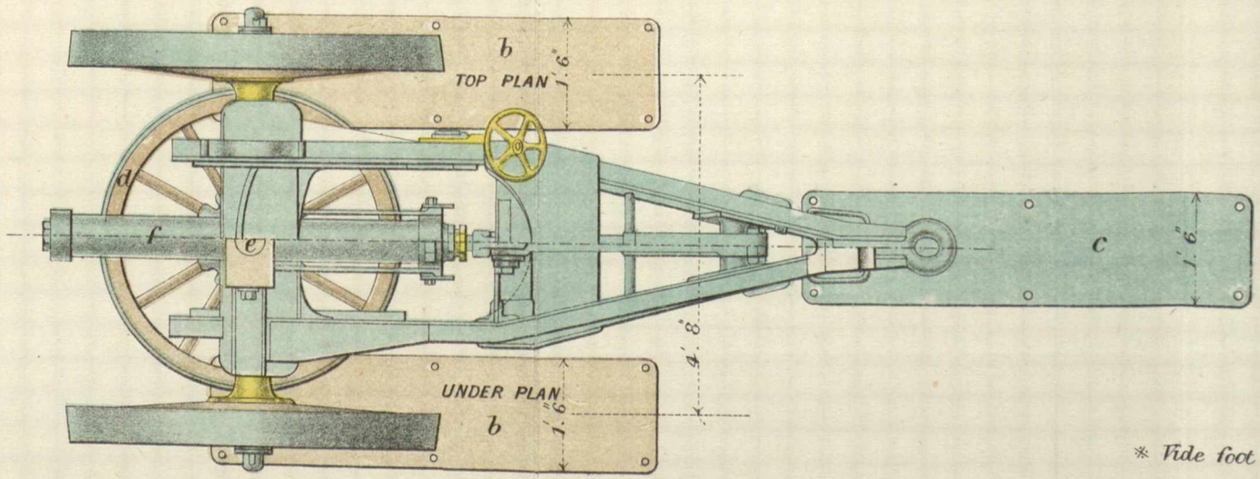
FOR CENTRAL PIVOT.



SIDE ELEVATION.

Sink the pivot block "a" vertically in a bed of concrete 6 to 7 ft in diameter.
The top of the pivot block must be 4" above the ground when finished.
*Place the wheel plates "b.b." 6 inches in front of pivot, and 4'8" apart between centre lines of plates, and place the trail plate "c" as shown.**
Place the circular wheel guide "d" over the pivot block "a". Insert the pivot plug "e" and fasten the Hydraulic Buffer "f" securely in it.
See that the bolts "g.h." of the hydraulic buffer and stay are properly secured, and prepare the buffer as described on the Inscription Plate.
NOTE. These carriages have fittings for attaching the Hydraulic Buffer to the anchoring apparatus for use in the event of there not being time to properly prepare the concrete and ground for the central pivot.

NOTE. If a wood platform be used under the wheels the height of the upper surface of pivot block above the concrete, must be increased by the thickness of such platform.



CAST IRON
WROUGHT IRON
STEEL
GUN METAL
WOOD

* Vide foot Note p. 10.

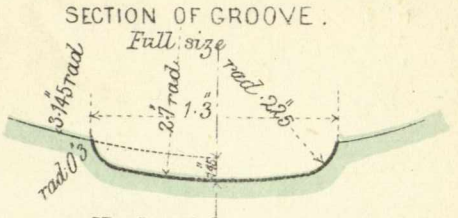
Scale.

Inches 12 9 6 3 0 1 2 3 4 5 6 7 Feet

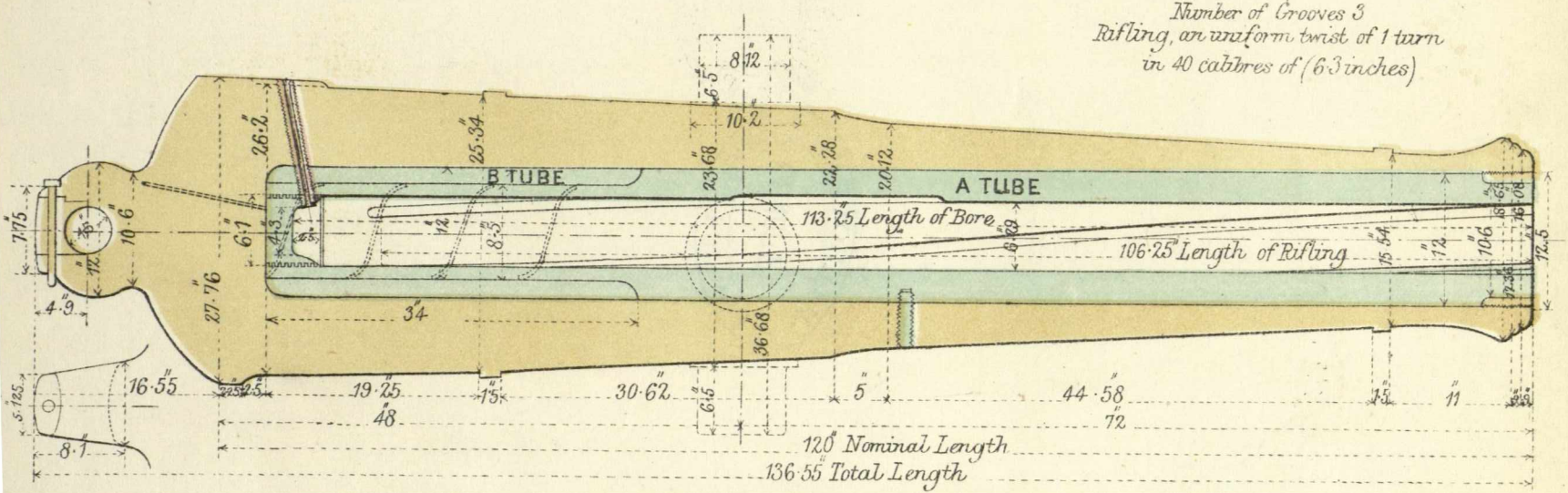
DANGERFIELD LITH. 22 BEDFORD ST. COVENT GARDEN. 3901. 5/85.

Frontispiece

ORDNANCE CONVERTED RIFLED 80 Pr 5 TONS. MARK I.
FROM 68 Pr 95 CWT.



Number of Grooves 3
Rifling, an uniform twist of 1 turn in 40 calibres of (6.3 inches)



2/88

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